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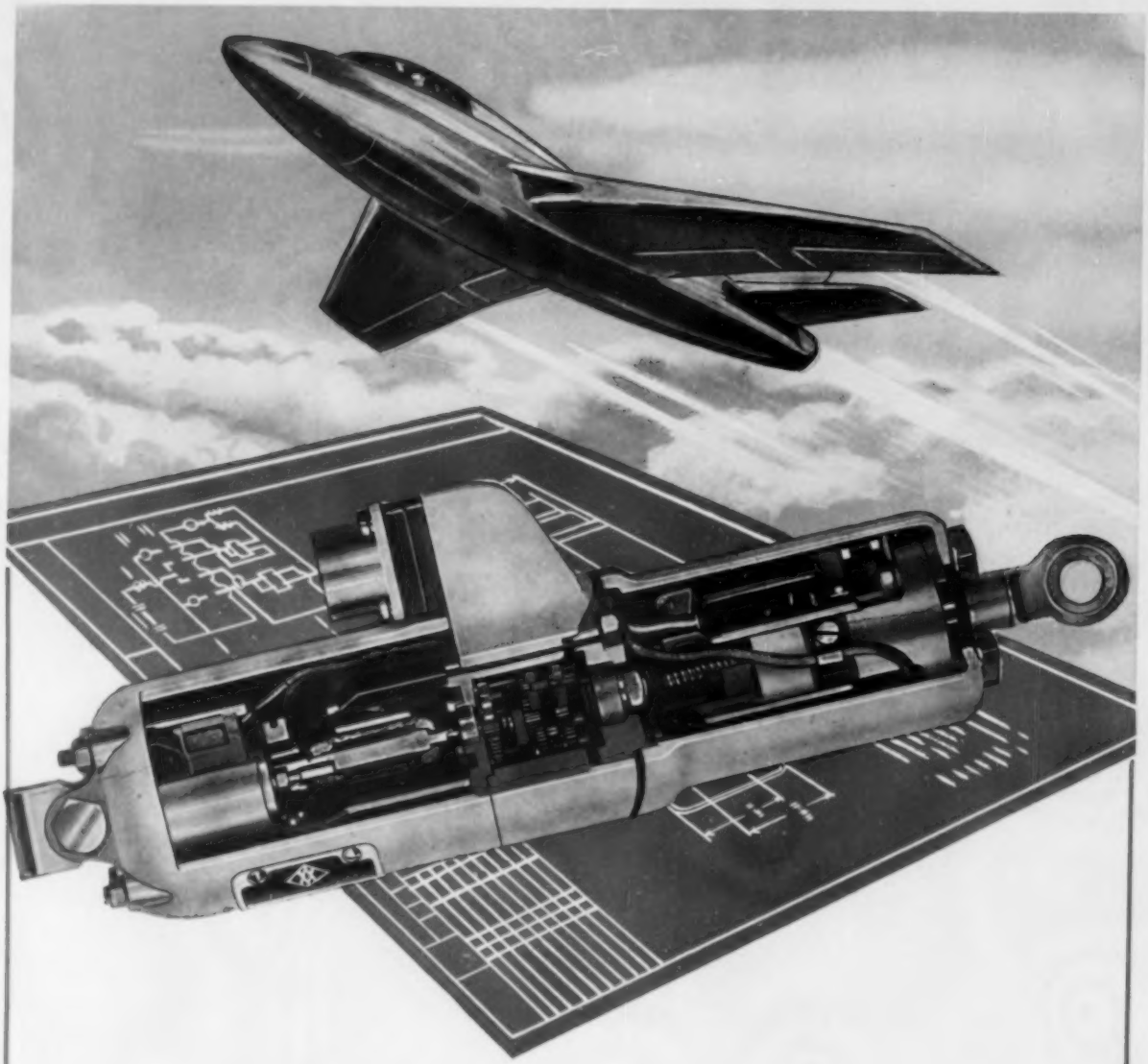

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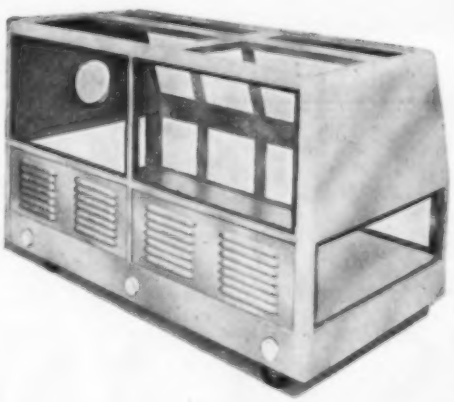

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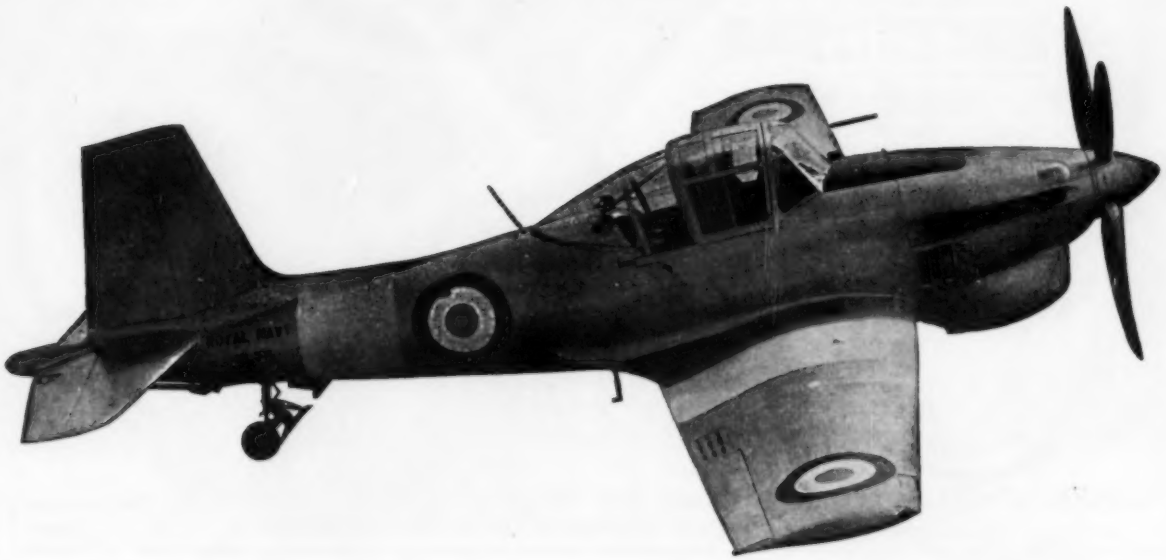

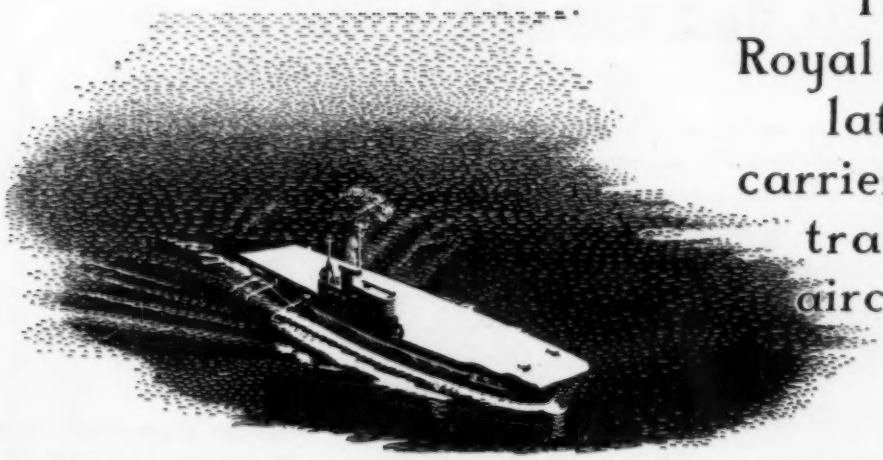

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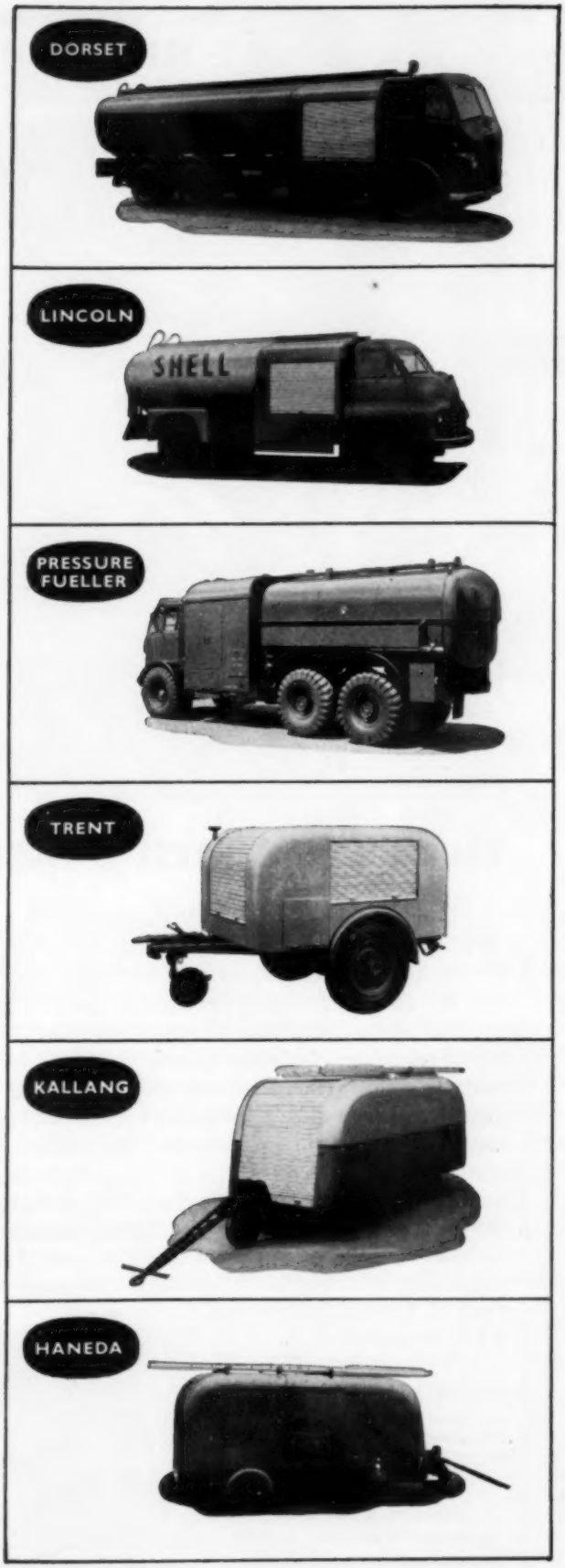

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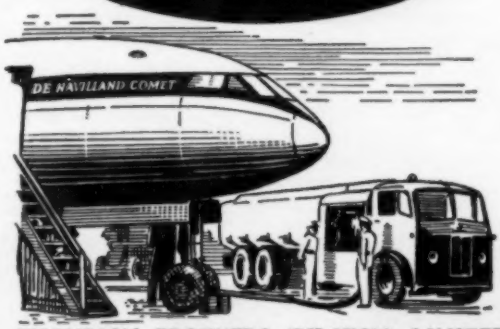

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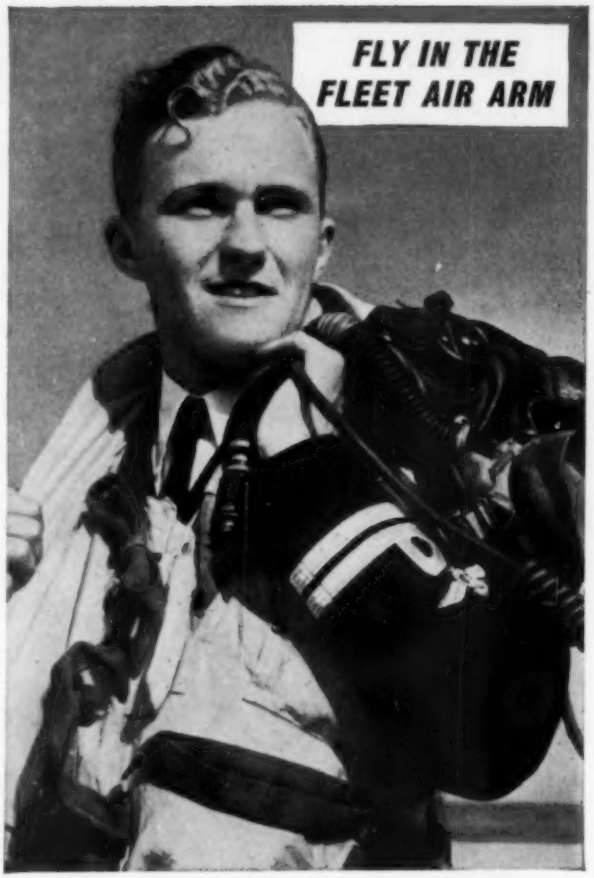

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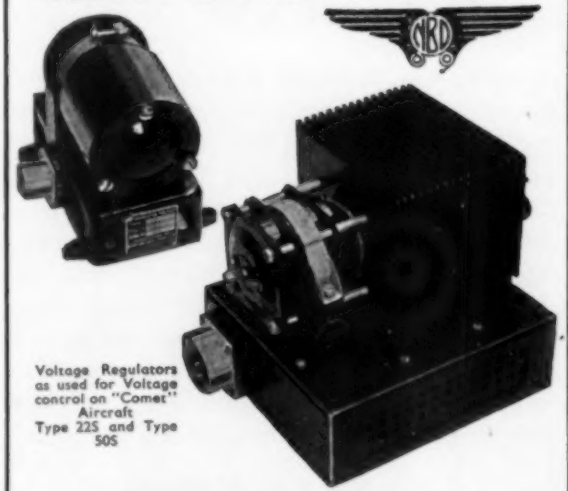

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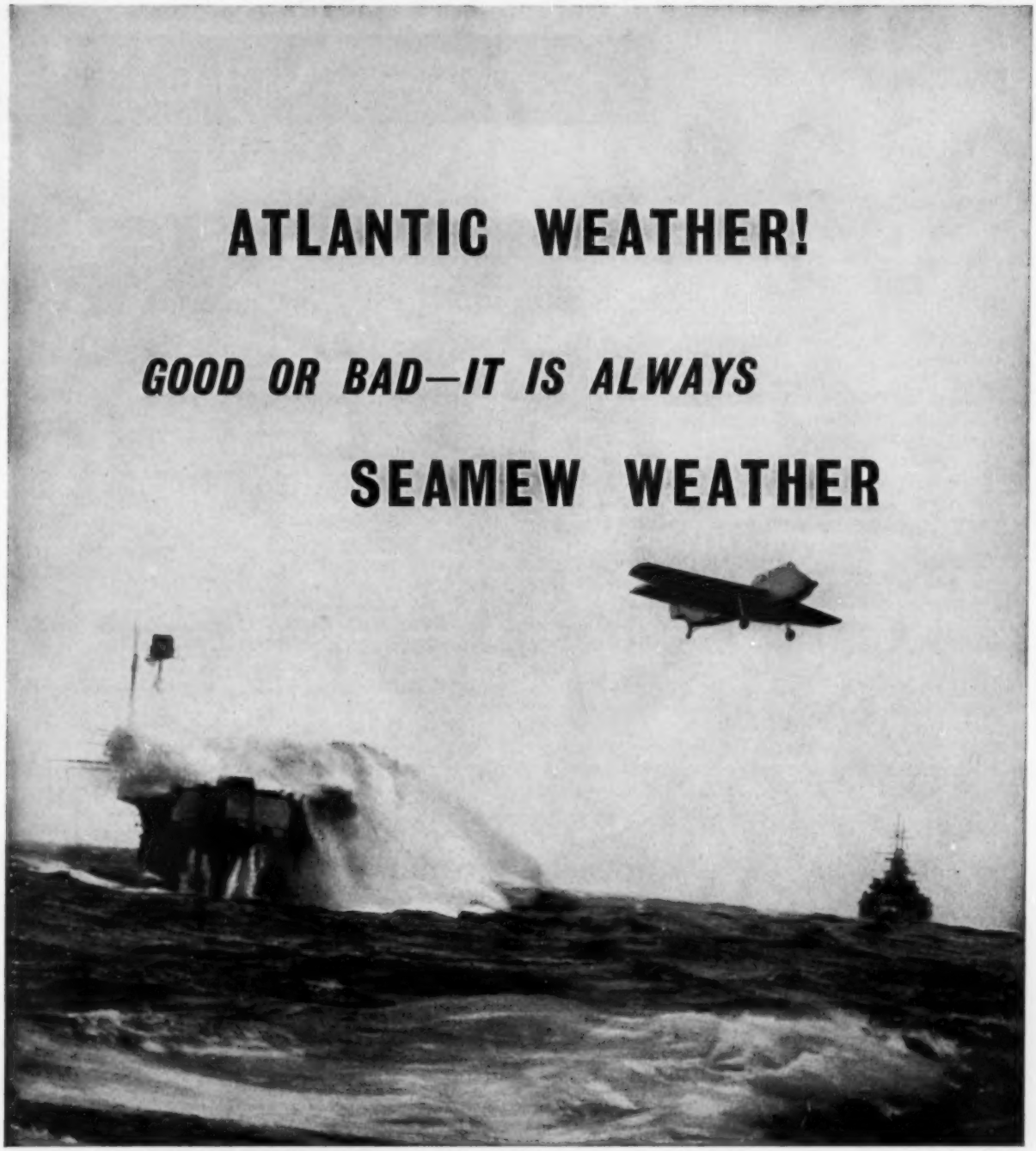

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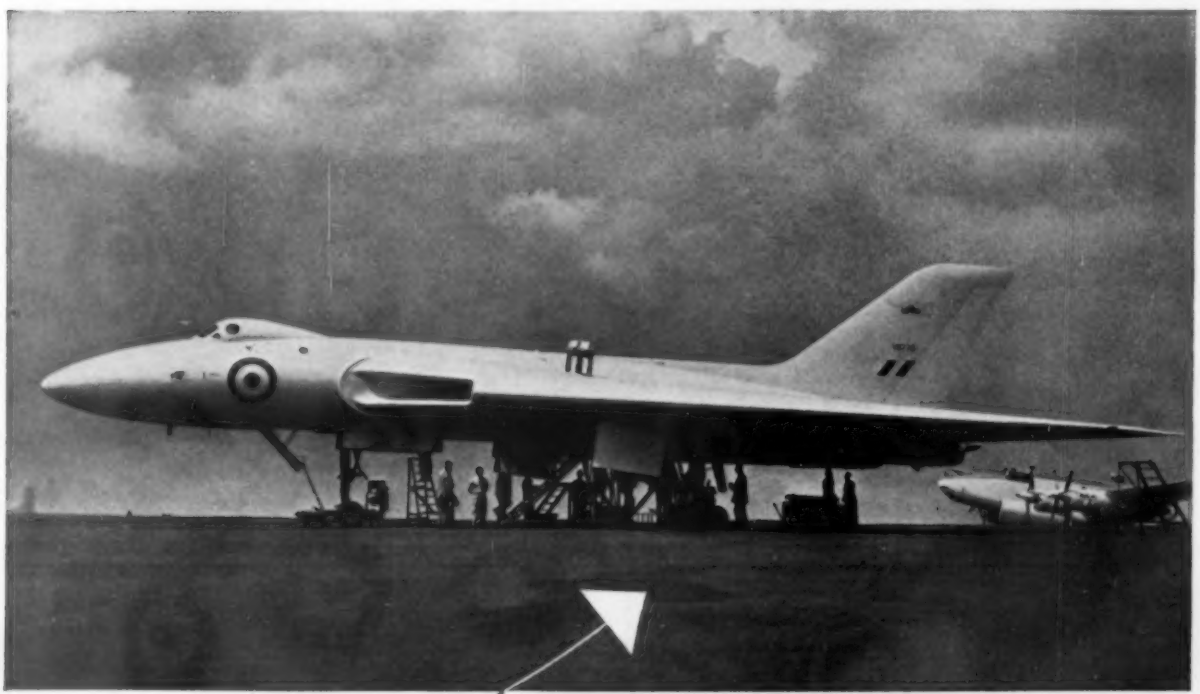

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Out of this Nettle . . .

WHEN the splendid symbol of peace and progress which is Britain's Comet is repeatedly struck from the sky in circumstances of mystery and horror (and no one can cavil at the words), the shock sweeps fast round the world. Thus the grievous blows dealt over India and the Mediterranean have been felt not by our own country and Commonwealth alone but by the whole of civilization; and civilization being founded on human values as well as on the achievements of science, messages of understanding have come from many nations. Especially we would mention America, where, a de Havilland representative reports, he found "a sense of extreme sympathy and the conviction that the troubles will be overcome"; and France, whose Civil Aviation Minister has affirmed, "The career of the Comet is not ended. The British effort is not broken, but only slowed down."

In gratefully acknowledging these expressions Britain gives her pledge that, if a technical fault lies hidden in the Comet, she will spare herself no pains or perils to find it and root it out. In the words of Mr. Profumo, Parliamentary Secretary to the Ministry of Transport and Civil Aviation, exhaustive investigations and tests will be carried out "as a major national research project by the Ministry of Supply," and the full resources of that Ministry have been made available for the purpose.

Mr. Profumo, we were glad to note, suggested that the opportunity should not be missed of "taking off our hats to those V.I.P.s on whose courage and genius the future of this great British project now relies."

Never was the term V.I.P. more truly used, for among the appalling uncertainties now besetting the whole of the great Comet project only one thing seems sure—that the men engaged—especially, of course, the test pilots and their flight observers—will not hesitate to grasp the nettle danger if they glimpse within it the flower of safety.

The Royal Auxiliary Air Force

ELSEWHERE in this issue appears the first part of a history of No. 603 (City of Edinburgh) Squadron, Royal Auxiliary Air Force, of which Her Majesty the Queen is Honorary Air Commodore. The twenty squadrons which, in the inter-war years, made up the Auxiliary Air Force, rendered fine service in World War 2. During the critical pre-war months they were equipped, alongside the Regular fighter squadrons, with the latest operational aircraft, and as soon as hostilities began they took their place as fighting units in the front line.

Let it not be forgotten that the status of the Royal Auxiliary Air Force (the title "Royal" was earned during the war) is still the same today; the Force is, in fact, an integral part of Fighter Command, and constitutes a not inconsiderable proportion of it. It will be remembered that the major United Kingdom air defence exercises held over the past years have been specially arranged to include weekends in order that the Auxiliaries might take a full share in them, and even with vastly increased complexity of the aircraft and their operations, the Auxiliary squadrons are still prepared to undertake full-time operation if any emergency should arise. It is significant that the second of all Air Force squadrons to receive its Standard after completion of 25 years of service was No. 600 (City of London) Squadron.

There is no reason why, in the defence of this country, the Auxiliary squadrons should be regarded as in any way different from other units in Fighter Command. The Auxiliary pilots, and the ground crews who support them, are well able to operate efficiently the fighters now in service and those due in service for many years to come; equally, early-warning and anti-aircraft duties will not exceed the abilities of the Auxiliary fighter control and light anti-aircraft squadrons. Nevertheless, there is a tendency in some quarters (though these appear to be the remoter and less well-informed quarters) to regard the R.Aux.A.F. as obsolescent. Surely it would be more fitting to ensure, for example, that full advantage is taken of the willingness of its members to undergo the specialized training courses run for Fighter Command as a whole.

FROM ALL QUARTERS

The Royal Tour: Final Stages

HER MAJESTY THE QUEEN and H.R.H. the Duke of Edinburgh are now on their way from Ceylon to Aden, where they will disembark for the last time from *Gothic*. They will continue their journey from Aden to Entebbe and, after two days there, from Entebbe to Tobruk, in the Argonaut *Aeolus*. The B.O.A.C. crew will consist of: F. A. Taylor (captain); C. R. W. Taylor (1st officer); A. C. Lacy (navigating officer); A. M. Ruthven (radio officer); A. S. Plumley (1st steward); B. Monet (2nd steward); Monica Tyndall (stewardess).

At Tobruk Her Majesty will embark in the royal yacht *Britannia*, which sailed to meet them from Portsmouth on April 14th with Prince Charles and Princess Anne on board. *Britannia* will then sail from Tobruk *via* Malta to Gibraltar.

Avro Shackleton maritime reconnaissance aircraft of the R.A.F. will provide an air escort for *Britannia* as she approaches Gibraltar, where the Queen and the Duke will arrive on the morning of May 10th. On disembarking the Queen will be met by His Excellency the Governor of Gibraltar, Sir Gordon MacMillan, K.C.B., C.B.E., D.S.O., M.C., and senior officers of the three Services, the R.A.F. being represented by A. Cdre. G. G. Barrett, C.B.E., Air Officer Commanding, Royal Air Force Gibraltar.

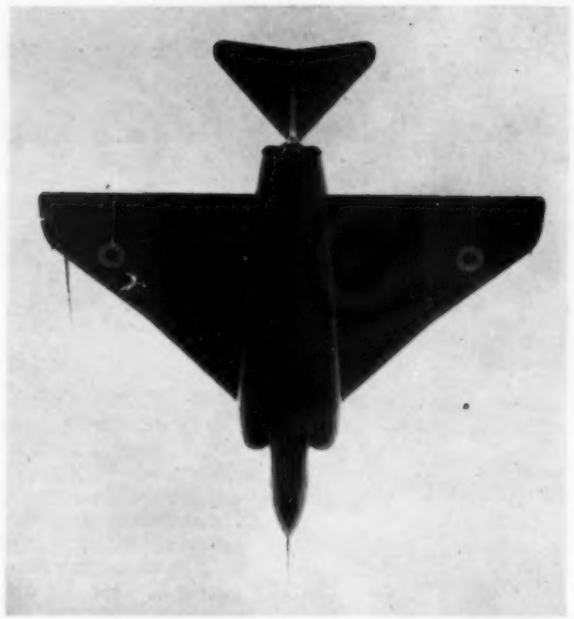
Later in the morning a combined Services parade will be held at R.A.F. Station North Front, the administrative arrangements for which will be the responsibility of the R.A.F. Lined up in the parade will be Shackletons—their crews standing in front—from the squadron which provided the air escort.

Early in the afternoon of May 11th, as *Britannia* leaves the harbour for the final stage of the voyage home, Shackletons will once more fly past the ship, and the shore batteries fire a salute.

Aerial salutes and escorts have been given at a number of places visited by the Queen and the Duke, and, for the last 450 miles of the journey in *Gothic* from Cocos Island to Ceylon, an air escort was provided by a Sunderland of No. 88 Squadron, based at Trincomalee, Ceylon. Four other Sunderlands from the same unit, led by A. Cdre. J. Cox, A.O.C., Ceylon, flew over *Gothic* in salute.

Hawker Siddeley and Titanium

ON his return from Canada on April 14th, Sir Roy Dobson, managing director of A. V. Roe and Co., Ltd., disclosed that, to further their interests in titanium, the Hawker Siddeley Group have bought Canadian Steel Improvement, Ltd., at Etobicoke, North Toronto, Ont. The subsidiary has one of the most modern plants in Canada and was formerly owned by an American concern—The Steel Improvement and Forge Company, of Cleveland, Ohio. Commenting on the purchase, Sir Roy said: "Canadian Steel Improvement specialize in high-quality precision forging of aluminium, steel and titanium. We will be expanding the plant and specializing still further in titanium, taking this vital new aviation raw material from the sponge to finished product.



DESTROYER: Ample wing area is a key factor in the design of the Gloster Javelin F(AW)1, for it allows this twin-Sapphire fighter to manœuvre at extreme altitudes. Seen here is the fourth—and latest—prototype.

We will be serving not only Avro Canada, the Group's jet engine and aircraft subsidiary in Canada, but also the rest of Canadian industry. Cyril Luby, at one time general manager of Rotol, Ltd., has been appointed president. There will be a very close technical link-up between our English subsidiary, High Duty Alloys, of Slough, and Canadian Steel Improvement. The new Group Investment in Canada adds substantially to our already heavy stake in the expanding Canadian economy. I am happy to report that Avro Canada is steaming ahead delivering Orenda jet engines and CF-100 all-weather fighters to the R.C.A.F. on schedule. More than 1,500 engines have already been delivered from a plant that was in the blueprint stage only three years ago."

Members of the new board of Canadian Steel Improvement are: Sir Frank S. Spriggs and Sir Roy H. Dobson, of the Hawker Siddeley Group, Crawford Gordon, Jr., president of Avro Canada, H. G. Herrington, managing director of High Duty Alloys, Slough, J. S. D. Tory, Cyril Luby, Fred McAlpine (secretary treasurer), and J. A. Welling, at present manager of the castings division of High Duty Alloys.

Further Hawker Siddeley news, received as we go to press, is that Mr. J. D. Stranks has been elected to the Board of Hawker Aircraft, Ltd., as works director. Now that company's chief experimental engineer, he joined their predecessors—Sopwith Aviation—as an apprentice in 1915.

SALVO START: The starter cartridges of the Rolls-Royce Nenes in the Hawker Sea Hawk fighters of No. 806 Squadron, Fleet Air Arm, are fired in unison aboard H.M.S. "Eagle," exercising in the Western Mediterranean. Just discernible, circling towards the mid-horizon is a Westland-Sikorsky Dragonfly airfsea-rescue helicopter.

A Handy Naval Weapon

CHANCE VOUGHT Cutlass F7U-3 tailless deck-landing fighters will soon be operating with the U.S. Fleet, according to a makers' announcement. The F7U-3—one of which makes a striking picture here—is powered with two Westinghouse J46 turbojets, delivering, with afterburners, a total thrust of nearly 12,000 lb. Supersonic speed was attained in dives during development flying and pilots reported very good handling characteristics throughout the sonic range. Rate of climb is quoted as more than 13,000ft/min and combat ceiling as over 45,000ft.

Notwithstanding its tailless design, the Cutlass is claimed to have remarkable low-speed handling characteristics, and to be unusually stable right down to the stall. The present F7U-3 can be catapult-launched with a bomb load of about 5,500 lb, but a developed version, intended primarily for attack and designated A2U-1, can be catapulted with a bomb load of more than 9,000 lb —a startling figure indeed. The A2U-1 will have longer range and increased armour protection. Normal armament of the F7U-3 consists of four 20 mm guns and a "belly pack" of air-to-air rockets.

Hubert Scott-Paine

FROM America comes news, as we go to press, of the death of Mr. Hubert Scott-Paine, in Greenwich, Connecticut, at the age of 63. In British aviation, he will be remembered in connection with the early days of the Supermarine Aviation Works, with pioneer airline work, and with the Schneider Trophy Races. To his aeronautical career we hope to devote space next week.

Joining Dunlop Aviation

IT is announced that A.V-M. C. E. H. Allen, C.B., D.F.C., B.A. (Cantab), M.I.Mech.E., has joined the Dunlop aviation division as liaison officer with the Ministry of Supply, the Air Ministry and aircraft firms. A.V-M. Allen, who was born in South Africa, joined the Royal Flying Corps in 1917 at the age of 18, and won the D.F.C. within a year. He has served continuously from then until his retirement last month, successively as an operational pilot, a flying instructor, R.A.E. test pilot and, latterly, as a senior officer of the Technical Branch. From 1927 to 1931 he studied engineering as a member of the R.A.F. officers' engineering course, Henlow, and at Cambridge University. Overseas he served on engineering duties in Singapore and the Middle East, and on general flying duties in India. He returned to England in 1940 and, after a short spell with the Ministry of Aircraft Production, he commanded Henlow from 1940 to 1943 and Cosford from 1943 to 1946. He was S.A.S.O. 43 Group before going out to the Middle East Air Force in 1949 as Group S.T.S.O. In 1952 he returned from Egypt to become Director-General of Technical Services at the Air Ministry.

A.V-M. Allen.

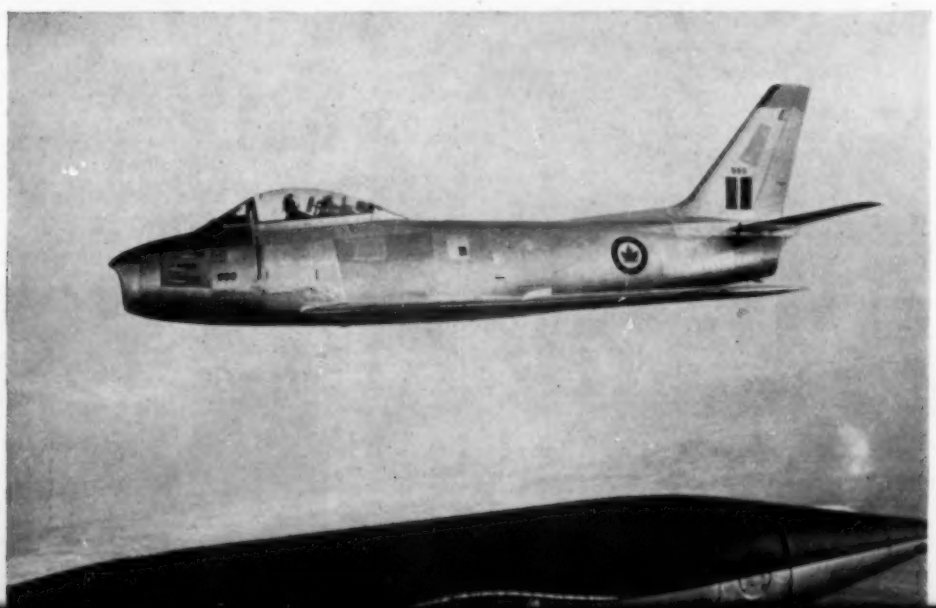
PREPARING TO BOARD? Its name—Cutlass; its Service—the U.S. Navy; and its proximity—a few feet to starboard of a Lockheed jet trainer (a tip tank of which is seen), suggest old-time tactics on the part of this Chance Vought deck-landing fighter. (See news item adjacent.)

A Belfast Loss—and an Appointment

TWO announcements were made by Short Brothers and Harland, Ltd., shortly before Easter. The first recorded "with deep regret" the death of Mr. A. W. S. Clarke, the Belfast company's chief engineer. He joined the firm in 1914, six years after they had produced their first aeroplane. The list of famous Short designs with which he was concerned is an impressive one, and as early as 1932 he was appointed assistant designer in charge of detail design on the six-engined Sarafand.

"His flair for design," writes a colleague, "was outstanding, and his honestly critical appraisal of schemes submitted for his approval earned the respect of all, even when accompanied by the bluntest of comments—a bluntness, however, which was never offensive, for he was essentially a kindly person. It is, indeed, in the peculiar quality of his honesty that the key to his character lay."

The second announcement was of the appointment of Mr. H. G. Conway, M.A., F.R.Ae.S., M.I.Mech.E., as chief engineer in succession to Mr. Clarke. Born in Vancouver in 1914 and educated in Edinburgh and at Cambridge University, he held similar posts with Aircraft Equipment, Ltd. (1938-45), and Dunlop Aviation Division (1945-47). Before joining Short Brothers he was technical director of British Messier, Ltd.



NINE, NINE, NINE: Photographed (like the Cutlass above) from a Lockheed jet trainer, this Sabre 5 (Avro Canada Orenda) is the 999th Sabre built by Canadair. Beneath the shapely canopy is Bill Longhurst, the chief test pilot.

The Proof of the Provost

First Provost/Vampire Course on its Way

Leg show: Ternhill Provosts in close echelon.

THE new R.A.F. flying training system is now coming into play. After a rather fluid post-war period of indecision and frequent changes, the routine has been largely adjusted to the needs of a jet air force. Where previously pupils might have flown any of five types of aircraft before qualifying for their wings, they will now fly only two, the Provost and the Vampire T.11. The stand-bys of the old system, the staid Prentice and the rugged Harvard, are steadily being replaced by the new types. The three principal factors in the new order are side-by-side seating all through, the high-powered basic trainer and the turbojet-powered advanced trainer. At first sight, such innovations might appear formidable, but in practice no great difficulties are foreseen. Certainly the Provost has so far given rise to no complaints.

The first course to be trained entirely in the new system recently completed basic training on the Provost at Ternhill, and *Flight* visited the station to see how this first stage went. Arriving in the office of the O.C. Flying Wing, and prepared to savour once again the rigours of a training station and the frustration attendant on the introduction into service of a new aircraft, we were immediately—and pleasantly—disillusioned. The station was attractive and businesslike, the sky teeming with Provosts and resonant with their as-yet-unfamiliar engine noise. The new trainer was most palpably giving good service.

After being warmly received by W/C. G. W. Garton, D.S.O., D.F.C., we settled down to find out about the Provost in service. Basically the new training schedule is as follows. It begins with 12 weeks of I.T.S. ground training, rather similar to that of the Army's Officer Cadet Training Units, and concerned mainly with personal qualities pertinent to the holding of a commission. This initial warming-up period is followed by a 30-week course on Provosts, covering substantially the same ground as the old Prentice course, but involving 120 hours of flying instead of 65 hours. The acting pilot officer, as the pupil-pilot is now styled, leaves his Provost course with a thorough foundation in the accepted range of ground subjects and a really useful number of hours on a machine which truly qualifies for the name of aeroplane.

The remarkable quality of the Provost is that it behaves in nearly all important respects like an aircraft of substantial size, while preserving completely those qualities of lightness and sensitivity which the R.A.F. has always demanded of a basic trainer.

After three weeks' leave, the pupil passes on to a 30-week course of 110 flying hours in the Vampire T.11. Though this may appear to be a considerable step forward at a comparatively early stage in his experience, we hope to show in the remainder of this story—and in a proposed sequel—that the step forward is not so radical as some might be led to believe.

It is on the T.11 that the pupil will gain his wings and also his first instrument rating. After a further period of leave, the now-qualified pilot goes on to an O.T.U. and learns the work of the branch to which he has been assigned.

This new scheme is eminently reasonable, and it contrasts fairly strongly with the old order. Hitherto, a pupil pilot might have had to fly first the Chipmunk or the Prentice, and then the Harvard, Balliol or Oxford, before achieving his wings. After that (and after having, in more recent times, obtained a "white" instrument rating on piston aircraft) he would go on to a jet A.F.S., learn to fly a Meteor, obtain a white instrument rating for jets, and pass finally to an O.C.U. He would first graduate as a "steam pilot" on piston-engined aircraft, and would not meet the crucial test of jet conversion until he was nearly trained. If this step were too much for him, however, then the initial training period and the concomitant expense would be wasted. It must be remembered that the cost of training must necessarily rise in proportion to the cost of operational flying and of operational aircraft. As more and more jet aircraft are introduced into service, it becomes increasingly necessary to produce not merely a qualified pilot, but a jet pilot.

It is to produce this jet pilot as efficiently as possible that the high-powered basic trainer has been adopted. The initial grading course, consisting of a score or so of hours on Chipmunks (usually operated by civil schools) is now considered to offer no advantage. The pupil comes straight from the I.T.S. to the F.T.S., and after two days of ground lectures he receives his first flying experience in the Provost.

During our visit to Ternhill we had the opportunity of flying the Provost, and were greatly impressed with its qualities. One immediately feels on take-off that the aircraft has the power to "go places"; yet with many of the characteristics of a large aircraft it handles, one might say, delicately. The Leonides engine gives it something of the feel of a release from gravity which is characteristic of the effortless performance of a jet. But despite its lightness and straightforwardness, the pilot must still manage the aircraft properly if he is to obtain the required results from it.

The first question we asked W/C. Garton was about the effect of 550 h.p. on an *ab initio* trainer. It was not till we had flown the aircraft that we realized how little effect there was, and how well the engine fits the airframe. We next enquired about the side-by-side seating arrangement. This is not new in a basic trainer, but it is novel in an aircraft with a performance similar to that of the Harvard. The general opinion among instructors was most favourable. The psychological advantage of side-by-side seating is difficult to define, but advantage there is. The instructor can more accurately assess his pupil's ability, and the pupil will more rapidly gain that confidence in his new environment which is most necessary to later success. More direct contact between instructor and pupil considerably eases the instructor's task, and lessens the nervous strain which may have existed before.

The station commander, G/C. R. J. B. Burns, O.B.E., and the O.C., Flying Wing, W/C. G. W. Garton, D.S.O., D.F.C., outside S.H.Q. at Ternhill.

Provosts on the sunny side of a cloud street. "Flight" photographs

Last but not least of the advantages is that the instructor has as good a view forwards as does the pupil. At Ternhill this was greatly appreciated during night circuits and bumps: no longer are the blind leading the blind in a Harvard.

One quality of the Provost which may at first seem surprising was particularly stressed at Ternhill—namely, the similarity of its cockpit layout to that of the Vampire T.11. This association, moreover, was supported by some similarity in the behaviour of the aircraft. The control column of the Provost, for instance, is virtually the same as that of the Vampire Trainer and Meteor 8. Stick-mounted pneumatic brake lever with rudder-bar-controlled differential braking make the problem of taxying in all three aircraft essentially the same. In the Provost the gun trigger has been suppressed and the buttons normally allocated to rocket-firing and gun-sight camera operation have been adapted as V.H.F. R/T. and T.B.A. muting switches. The use of pneumatic brake and flap systems might at first seem extravagant in a basic trainer, but they contribute considerably to the "grown-up" feel of the aircraft. Other good points for a trainer are excellent all-round visibility, even while taxying and landing, adjustable seat-height and rudder pedals, and efficient cockpit ventilation.

We spoke to some of the pupils who had visited the de Havilland factory at Chester where Vampire T.11s are being built. They remarked particularly on the similarity in cockpit layout between the Provost and the T.11. As for the behaviour of the Provost, we noticed that it does not bounce or balloon wildly if dropped on the main wheels on landing. Throughout our stay at Ternhill, we saw none of those sickening, kangaroo-like progressions down the runway which were so familiar on the very light basic trainers, and even on Harvards. The Provost lands like a large aircraft. Another quality was throttle response on final approach. At 2,600 r.p.m. and approximately −6 lb boost, power returns slowly as the throttle is opened, and there is some of the lag characteristic of the jet engine. We cannot help feeling that the transition from Provost to Vampire T.11 will be less of a step than, for instance, from Chipmunk to Harvard, or from Harvard to Meteor 7.

The introduction of the Provost has brought no radical changes in the flying-training syllabus. The average time to first solo is about 12 hours. Instrument flying accounts for 13 hours, mostly simulated with two-stage amber, plus a final test. The standard of this test is slightly below that

(*Concluded on page 510*)

The remainder of the photographic formation returns to base.

HERE AND THERE

Kenya Air Reinforcements

A FLIGHT of four Vampire fighter bombers is to be detached to Kenya to assist in the drive against the Mau Mau terrorists. They will attack gangs and their hideouts with rockets and cannon fire.

Canadian Training

ACCORDING to a recent count, 2,682 aircrew from other Atlantic Pact countries have been trained in Canada since the alliance was formed; 950 more are still under training. Some 1,940 of those trained, and 412 still under instruction, are from the United Kingdom.

British Aircraft Exports

AIRCRAFT-INDUSTRY exports for the month of February 1954 totalled £5,311,249, compared with a monthly average of £5,506,295 over the previous twelve months. The figure was divided as follows: Complete aircraft and parts, £2,996,932; engines, £1,919,885; electrical parts and appliances, £353,156; and tyres, £41,276. Total aircraft imports for the month were £1,149,329, or 22 per cent of exports.

Smaller, Gentler and Quicker

THREE new items of aircrew equipment are displayed at the exhibition of the Aero Medical Association in Washington. One is a new flat, back-type parachute pack for which a great saving in aircraft cockpit space is claimed; another is a special suit with integral parachute harness designed to spread over the whole body the shock of canopy deployment at high speeds; and the third is a suit with integral parachute and safety harness which can be rapidly plugged into the aircraft. A special quick release is incorporated to allow the pilot to undo his harness with one hand.

THE EXPERT: The dusky Nigerian gentleman with his back to the camera appears to be explaining the working of a Hiller 360 helicopter to his colleagues. The Hiller is being used to aid in a search for oil and for spraying the base camp with dieldrin, a Shell anti-malarial agent (see below).

Hillers on Safari

TWO Hiller 360 helicopters, one of which is shown in the photograph above, are under contract to the Shell-D'Arcy Petroleum Development Company of Nigeria, Ltd., from Pest Control, Ltd. They are employed for transporting personnel and light equipment between the base camp and the various exploration areas, for spraying the camp (as mentioned above) and are available, when fitted with detachable litters, for the rapid evacuation of any casualties.

Four Million Air Miles

OVER 23,000 hours in the air should provide good material for an autobiography, and the fact has been recognised by W/C. Robert McIntosh, D.F.C., A.F.C., lately chief pilot to Airwork, Ltd., and still one of their executives. He hopes that the book will be published next autumn.

The Society Only

WE have received enquiries about public admission to the Royal Aeronautical Society's Garden Party, to be held at London Airport on June 13th. This annual event, however, is always a private one, and tickets are available only to Royal Aeronautical Society members and their friends.

Brough Old-timers

A SILVER salver inscribed with the names of the 61 senior members of Blackburn and General Aircraft, Ltd., was presented by them to Mr. Robert Blackburn, chairman of the company, who has himself been connected with it for the longest time, 45 years. The 61 members have an aggregate length of service of about 1,700 years.

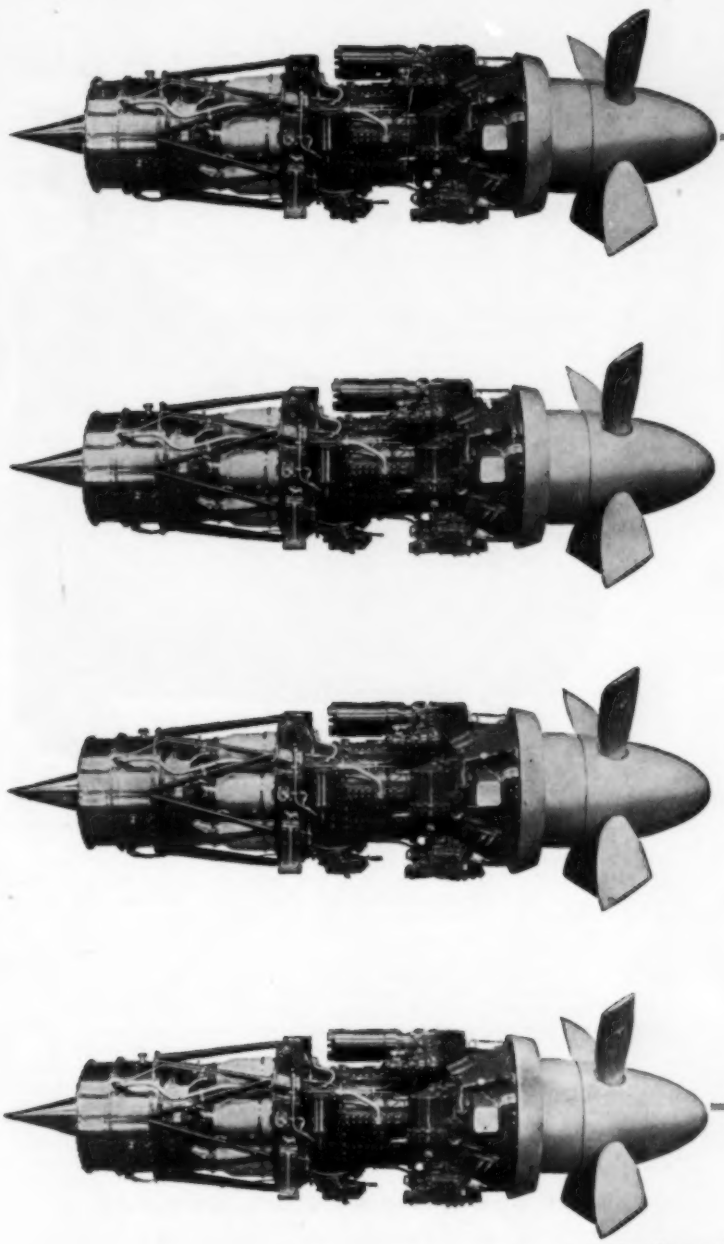
New Science Museum Lecturer

SUCCESSOR to Mr. G. Tilghman Richards, who recently retired from lecturing at the Science Museum, South Kensington, after holding the post for 25 years, Mr. G. B. L. Wilson, M.A.(Cantab.), M.Inst.Gas.E., gave his first lectures there on April 5th. He was formerly an engineer, and a gas-industry manager, by profession.

About the Nomad

TO appear in our next issue is a full, especially illustrated description of the Napier Nomad engine. Incidentally, an allusion in our last issue to this unit having sleeve valves will, it is hoped, have been recognized by most readers for what it was—a slip. The Nomad, of course, has no valves at all; of most unorthodox design, it is a compression-ignition engine which serves as both primary power source and gas-producer for an exhaust turbine.

COMING AND GOING: Seen arriving at Southampton on April 9th are Sir Thomas Sopwith, chairman of the Hawker Siddeley Group, and Lady Sopwith. They were met by their son Tom (right). The second picture shows Mr. Edward Jefferson, general manager and resident director of Hawker Aircraft's Squire's Gate factory, and his wife on departure from London Airport, on April 10th, for New York. Mr. Jefferson will deliver a paper describing Hunter production before the Aeronautical Division of the S.A.E. Before leaving he said that Hunters would be in service next month.



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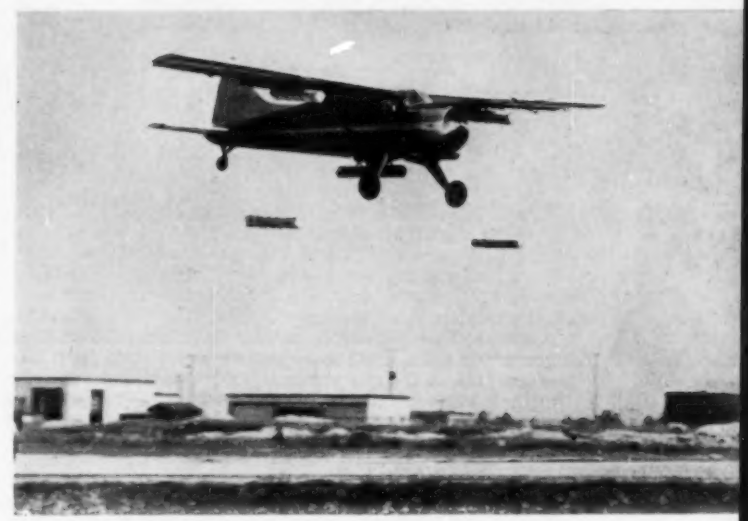
BEAVER—FARMER'S BOY

Quick Conversion for Spraying, Fertilizing and Supply Dropping

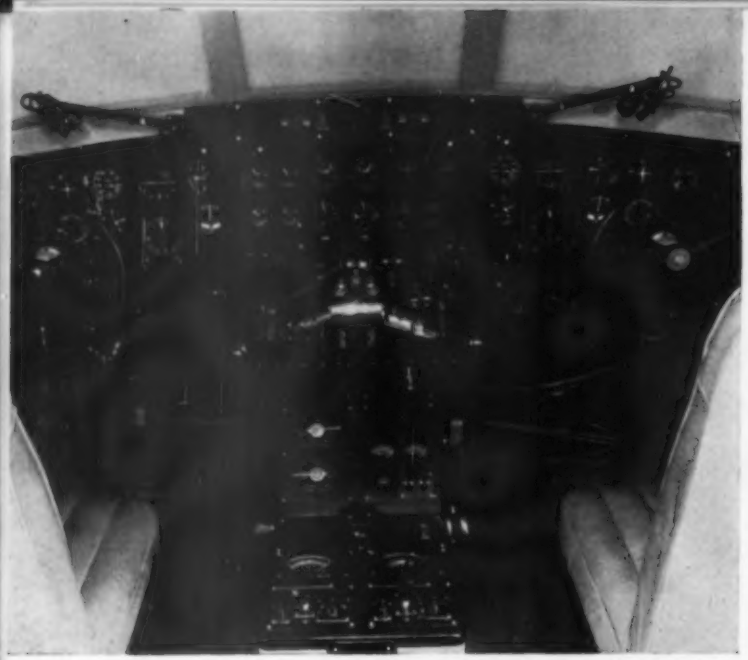
ALTHOUGH the new "pastoral" version of the de Havilland Canada Beaver is not (not yet, at least) equipped "to plough and sow, to reap and mow," like the farmer's boy of the old song, it is nevertheless a remarkably versatile piece of agricultural apparatus. The makers point out that hitherto the adaptation of agricultural aircraft from one function to another has been a laborious operation, involving a considerable amount of time and frequently obliging the operator to employ several machines, each one fitted for a special job. The new Beaver, however, is a triple-duty aircraft, combining the functions of spraying, fertilizing and supply-dropping, and allowing conversion from wet to dry distribution and *vice versa* to be made in less than an hour. Fixture of the supply-dropping equipment is achieved in a few minutes. The economy which this facility affords should, in the makers' words, "have a far-reaching effect in countries where the reclamation of hitherto unproductive land, and the subsequent control of pestilence, are made practicable only by treatment from the air."

The Beaver's performance (at its all-up weight of 5,100 lb it takes off in 450ft in still air and climbs steeply at 1,100ft/min) enables it to operate from small air strips near the areas undergoing treatment. For aerial top-dressing and seed-spreading, a hopper of 35 cu ft volume, carrying up to 1,850 lb of chemical fertilizer or seed discharges under gravity through a chute. A roof hatch facilitates quick loading and the average time between the landing of an unladen Beaver and its take-off for the next job is given as 65 seconds. This allows 20 round trips to be made in one hour, and 165 acres to be dressed at a coverage of 225 lb/acre. Density of coverage is governed by the aperture of the chute door, which can be selected by the pilot. For liquid-spraying operations the chute unit is removed and a sump-and-bag tank assembly fitted inside the hopper, with its filler neck secured to the roof hatch. The flexible tank carries up to 220 Imperial gallons of fluid, which it feeds to spray booms emerging laterally and braced to the airframe by struts. At the outboard ends of these booms are rotor units, consisting of wind-driven fans rotating wire brushes which disperse the fluid in droplets. Valves at the rotor heads permit variation of the discharge rate between one and 50 gal/min, and choice of suitable droplet size is afforded by a variety of brush sizes and types, and fans of various pitches and capacities. From a height of 25ft and at an air speed of 90 m.p.h. the swath width would be 120ft.

For supply-dropping the Beaver has four carriers, each for 250 lb, beneath the wings, and another on the under-side of the fuselage for 800 lb. Bundles of fencing posts, and similar agricultural materials, can be dropped free from 20-30ft with negligible damage.



In the top picture the "pastoral" Beaver is discharging chemical fertilizer and in the second is dropping supply-containers from under-wing carriers. Another carrier is fitted below the fuselage. On the right is a close-up of the delivery chute, with adjacent fuel and electrical services encased in stainless-steel conduits. Below, the spray boom is seen in place.



The cockpit of the new AT110 ground trainer, showing the instrument and control layout.

IN ON THE GROUND FLOOR

Air Trainers, Ltd., Twin Simulator with Mechanical Computor

THE flight simulator has come into its own. What used to be a small blue sweat-box perched high on a pedestal full of pneumatic tricks has developed into the vastly complicated and ingenious device now referred to as a flight simulator. Hitherto only the airline companies have used electronic simulators for crew training and familiarization, but now the Services, too, have taken them up. Tremendous ingenuity is being used to reproduce in an essentially lifeless machine all the characteristics of a live aircraft, and the "boffins" who design these machines have succeeded in reproducing practically every one of the great variety of flight conditions to which an actual aircraft is subjected.

Basically, ground trainers can be divided into four main types: those which represent a specific aircraft; those which do not; the fixed-base type whose frame does not move on its mounting; and the movable machine which pivots like the traditional Link Trainer.

When *Flight* visited Air Trainers, Ltd., of Aylesbury, recently, they were making all four types. They first produced the basic Link Trainer, which was originally designed in America. Then, after the war, they brought this design up to date by equipping it with pitch and boost controls, flaps and undercarriage. The developed machine became known as the D4 (Services D4 Mk 1), many of which are now used, both in the Services and by civil companies.

Last year, Air Trainers produced the D4 Mk 2. This is a moving machine externally similar to the D4 Mk 1, but equipped to simulate approximately the performance of a Meteor. It is fitted with G4F compass, retractable undercarriage and flaps, I.L.S., dive brakes, pistol-grip control column, and sliding throttle of the Meteor type. It is "single-engined." The D4 Mk 2 was described briefly in *Flight*, April 10th, 1953, and at that time deliveries to the R.A.F. were just beginning. Many of these machines, called AT50 by the makers, are now being produced for export to several foreign governments, and they are at the moment being built at Aylesbury on a production-line basis.

Air Trainers have now produced the electronic AT30, a twin-engined jet-fighter simulator for the Meteor. As one of the accompanying photographs shows, the cockpit layout, apart from the two top rows of instruments, is identical with that of the Meteor. The non-standard instruments include I.L.S., zero reader, clock, radio altimeter, D.M.E. and radio compass. The AT30 is so far a "one off" machine, and has been installed at R.A.F. Station Driffield for experiments in simulated instrument flying for pilots undergoing jet conversion.

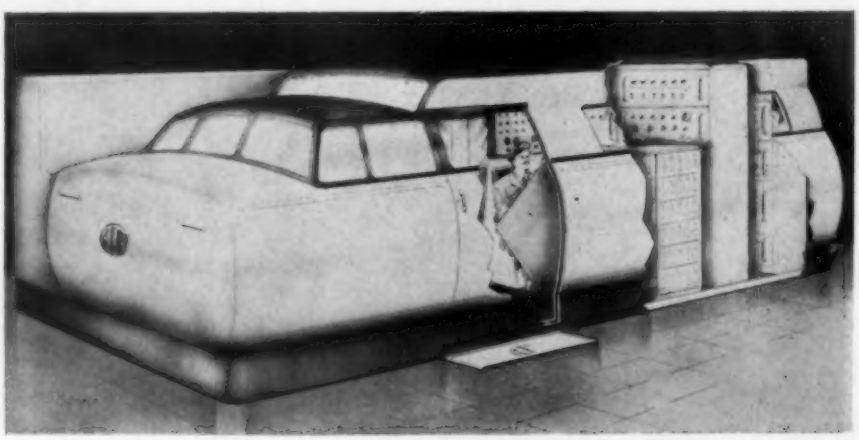
The machine is of the fixed-base type, but it reproduces high-speed buffet by actual shaking of the cabin, and it also allows the simulation of the traditional gamut of hair-raising failures. The aircraft track is recorded by a creeping needle on a rectangular plotting board. This replaces the traditional crab and table. The cockpit canopy is made in frosted material, through which it is impossible to see, but which allows daylight to enter; this gives an excellent impression of flying in cloud. For simulated night flying, black cloth covers can be fitted externally and secured with pop fasteners.

Displayed at Farnborough last year was the AT100, a twin-engined side-by-side two-seater moving trainer, corresponding approximately to Convair 240 performance. It has a cruising speed of 165 m.p.h. at 16,000ft, maximum speed of 326 m.p.h. and a sea-level stalling speed, with flaps and without power, of 100 m.p.h. The instructor mans a conventional desk and crab.

One climbs into the AT100 from the back, and walks forward to the large pilot's compartment, where the full flying and engine instruments and controls are fitted. Automatic radio compass, manual loop, manual and automatic radio-range equipment, D.M.E., I.L.S. and three-light marker equipment are mounted in a panel in the ceiling. The AT100 is therefore capable of reproducing realistically the full range of blind-flying and airline procedures.

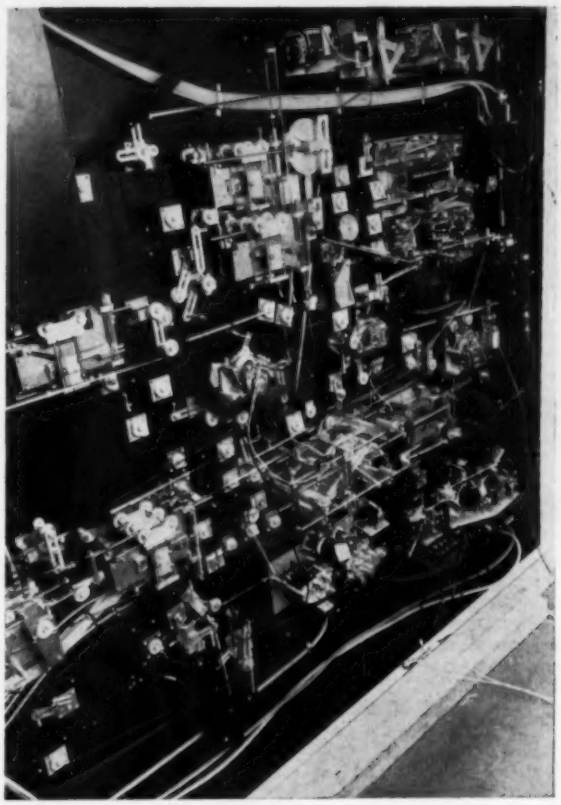
Flight's representative made a short flight in the AT100, which handles pleasantly enough, being light, sensitive, and responsive. He did notice the familiar "feel" of the D4, but, as the device is not designed to reproduce a particular aircraft, it can do no more than simulate the behaviour of aeroplanes in general. It is, however, extremely useful for general training, and has what is probably the unique characteristic of a moving cabin for a two-seat twin-engined trainer.

The moving trainer undoubtedly has great advantages in flight simulation, since a large part of a pilot's reactions are



An artist's impression of the complete AT110 installation.

The section of the apparently complicated mechanical computor of the AT110 which co-ordinates control movements and instrument reactions.

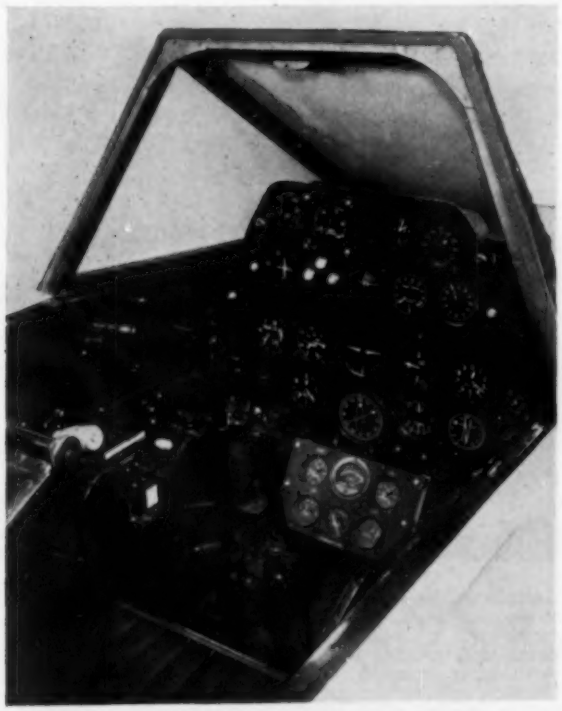


based during instrument flight on physical sensation of aircraft attitude. The pilot is always taught to ignore physical sensations in blind flying, yet, when he is momentarily occupied with some control in the cabin, physical sensation is a major factor in giving warning of initial change in attitude. This is particularly true in the case of engine failure in a twin. As soon as an engine fails, the pilot must close throttle, feather the airscrew, switch off petrol, ignition and boost-pump. While he is thus engaged, the aircraft is naturally yawing and rolling towards the dead engine.

In a fixed-base trainer, there is no sensation of roll to warn the pilot when the aircraft is excessively displaced from the level attitude. In a moving-base machine of the AT100 type, these sensations are produced by the actual roll of the machine, and instinctive corrective action corresponds more closely to that which would be taken in an actual aeroplane.

The foregoing machines, except the AT30, are all of the electro-mechanical moving type. We come now to a very ingenious simulator, the AT110, which has been designed with the intention of producing a relatively cheap and simple twin- or four-engined simulator for general airline-pilot training. It has a fixed base and "flies" very well indeed. The major innovation in the AT110 is the fact that its computor is almost entirely mechanical and pneumatic. The great number of "black boxes" required in the average comprehensive electronic simulator are usually ranged in formidable batteries, and often require a whole room to themselves. The same section of the AT110 is simply screwed on to a panel about 7ft high and 20ft long. At first sight, it is a bewildering maze of levers, pulleys, vacuum lines and steel tapes. Yet there is hardly any electrical apparatus in sight—merely a few small motors and a number of contacts. The "engines" are simple mechanical units, identical and placed next to each other in a corner of the panel. If required, more engines can be added by simply fitting additional engine units.

Control movements are transmitted by cables and tapes to a series of mechanical computors which correlate and balance the various inter-acting factors to produce the correct instrument indications, either mechanically or by autosyn. The actual control column loading is applied by bellows behind the instrument panel, and no major mechanical stresses are transmitted to the computors. Nearly all linkages are by steel tape, which can be easily fitted and adjusted, and just as easily renewed if necessary.



The cockpit of the AT30 electronic, fixed-base Meteor simulator, showing the two additional rows of instruments at the top of the panel.

Once one has got over the initial surprise of seeing this machinery, one realizes that it would be relatively simple to learn to maintain it. The mechanical parts, should they fail, are perfectly easy to replace, and the type of maintenance required would be well within the capabilities of a mechanic and electrician. This, of course, has tremendous advantages for the prospective operator, who must always consider the maintenance of an inherently complicated device like a simulator.

We made a short trial of this machine also and were impressed by its flying qualities. Its performance is based approximately on that of the Convair 240, and the windscreen panels, though of simple wood and frosted glass, are so shaped as to give an excellent impression of an aircraft of this type. The mechanical computor has imposed practically no limitations on the number and type of characteristics which it simulates. Control loads vary with speed; full engine-starting procedure can be practised; all the standard failures can be fed in, with the appropriate results; and, last but not least, the noise simulation is excellent.

The realism of the AT110 is perhaps the best we have found in any of the number of trainers we have sampled. While flying the machine, after having started up, taken-off and climbed to a few thousand feet, we were subjected quite unexpectedly to a number of problems; the starboard engine ran rough, and had to be cared for. Rough air was turned on and, finally, an engine was unexpectedly cut. It was while we were coping as quickly as possible with the unfamiliar engine controls that the aircraft became almost inverted in a steep dive before we were aware of it. Here, the lack of any physical warning of attitude-change makes itself felt, but it has this advantage: the pilot must concentrate visually on his flying instruments and cannot but ignore physical sensations. He is thus taught quite firmly the

IN ON THE GROUND FLOOR . . .

traditional technique of relying absolutely on instruments and of keeping a continual check on them.

We found the final approach and landing particularly realistic. For general twin-engined training purposes the AT110 is by far the best machine we have yet seen.

In addition to the actual flying controls, Air Trainers intend to fit a full range of navigation equipment in accordance with customers' requirements, as in the case of the AT100 already described. The associated equipment, together with the instructor's control panel and track recorder, will be fitted in the cabin behind the present flight deck. The mechanical computor constitutes one wall of the cabin and cockpit.

Elsewhere in the Air Trainers factory we were shown the Elizabethan and Viscount fixed-based electronic simulators which are being produced for B.E.A. The Elizabethan is in fact the crew compartment taken from the first production prototype Elizabethan registered G-AGUA. This machine was at the time of our visit practically ready for delivery to B.E.A.; the Viscount was not quite so advanced.

Before we left Aylesbury, we discussed with Mr. L. Malec, joint general manager of the company, the relative merits and demerits of the various types of trainer. Mr. Malec considers that the day will have to come when the simulator reproduces such effects as g loadings. Particularly he mentioned the development of simulators for visual flight. He explained an ingenious system, already employed in a car-drivers' trainer, for presenting an external landscape to the pilot in such a way that he could make a realistic approach and landing on a runway projected on a screen in front of him. Dusk, dawn and poor visibility could be reproduced. It would thus be possible to simulate a complete bad-weather approach to bring the pilot out of cloud at a low height by night or by day to complete an actual poor-weather touch-down. The instructor could, of course, leave him in cloud all the way down, thus forcing him to make the critical decision to go round again when his break-off height was reached. This is the most realistic and the most useful form of simulator, and future developments on these lines will be watched with great interest.

PROOF OF THE PROVOST (continued from page 505)

required for a white instrument rating. T.B.A. approach exercises are no longer required, and the set is used purely as a navigation aid and for let-downs, which are made from over the inner marker. Simulated high-level maximum-rate let-downs are made from 8,000ft with full flap, throttle closed, and at 100 kt, which gives a realistic rate of descent of 2,500ft/min. This is probably a very fair foretaste of the type of let-down which is later learnt in the Vampire. Although at present Ternhill has a "steam" homer (i.e., a manual loop), a special hut is already constructed, and C.R.D.F. is shortly to be installed.

Sixteen hours of aerobatics are included in the syllabus, ten of them solo. Pupils also complete eight hours of solo formation flying with stream take-offs and landings and the usual series of formations. Rapid breaking and re-joining are particularly emphasized. Night flying includes about six hours in the circuit and on cross-countries. Navigation by day consists of seven dual and six solo hours culminating in a two-hour solo cross-country without refuelling.

Ground training follows the traditional sequence of airmanship, meteorology, navigation, aerodynamics, aviation medicine, leadership, P.T. and games. Pupils spend 22 hours studying basic engine principles, the Leonides, and engine handling, but do not at this stage study the jet engine.

While we were at Ternhill we spoke to some of the pupils, instructors, the O.C. Flying Wing, the Station Commander, G/C. R. J. B. Burns, O.B.E., and the A.O.C. 23 Group, A.V-M. G. D. Harvey, C.B., C.B.E., D.F.C., and all of them approved of the Provost. Its serviceability is good, and its training qualities excellent. There was a general feeling that this is a very real step forward in flying training; the final stage, it was felt, should be the introduction of an aircraft of the Jet Provost type.

The course we went to see finally passes out this month, and after a period of leave it is due to go to Oakington for advanced training on the Vampire T.11. We hope to visit them there, and to find what their experience has been of the new system.

C. M. L.

COOL GALES SHALL FAN . . .

THE cold-air units designed by Hamilton Standard of America and built in England by de Havilland Propellers, Ltd., were described at some length in our issue of July 24th, 1953. They are now being installed in a number of British prototype aircraft and the example depicted on test at Hatfield (right) is for a new British fighter. The units are designed for the cooling of fighter cockpits or airliner cabins, and in conjunction with heat-exchangers they reduce the temperature of compressor-tapped air by 300 deg C or more. The two types now being manufactured deliver 20 lb and 75 lb of cooled air per minute respectively. While on test they are remotely controlled and their performance measured at the panel shown in the picture above. With the valves seen on the right of the picture set to give the required running condition, temperatures and pressures are checked and r.p.m. measured electronically. On the left are two RU.20 units, one complete and one dismantled; in the centre foreground are the turbine and fan, which are the basic components. The RU.20 unit, incidentally, has a matter of some 60,000 hours of operational experience behind it in American fighters.

Right, cold-air units on test at Hatfield. Below, two Type RU. 20 units, one complete, one dismantled.

He was in a Karachi tram yesterday

Inductor Pressure Gauge

Like so many others this year, this air traveller has "come to Britain", aided—probably unknown to him—by Smiths instruments. Passengers in aircraft on routes all over the globe owe a debt to Smiths, to instruments recognised by crews of many races for their sound design and never-let-you-down reliability.

A recent addition to the wide Smiths range is the Inductor Pressure Gauge for remote electrical indication of oil and fuel pressures up to 200 p.s.i. The indicators can be of the single long scale type or twin-scale, calibrated 0-40, 0-60 or 0-150 p.s.i. for oil pressure, and 0-75 p.s.i. for fuel pressure.

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THE FABLE OF MABEL THE MINOSAUR

It all happened several million years ago, in one of those intervals between the Great Ice Ages . .

Life in those days was nasty, brutish and short ; the law of the jungle prevailed, and progress—such as it was—meant merely a crude interpretation of the survival of the fittest.

The Mrs. Bruin's Academy of the period was inhabited not by Tiger Tim and Jacko, Jumbo and so on, but by creatures of hideous proportions and frightful savagery. There were foul, poisonous insects, evil-smelling plants, horrible sabre-toothed fishes as large as submarines, preposterous pterodactyls, dreadful dinosaurs and monstrous minosaurs.

And this fable is about a very remarkable minosaur whom we will call Denis. Denis was exceptionally intelligent (for minosaurs) ; he had read his Darwin and so knew what his species might expect from posterity. He was also peace-loving, crazy about games and fond of soggy cabbage.

"Look here, Mabel," he said to his wife one day, "it's time we began to think of the future. This is a tough life. We are threatened on all sides, and frankly I can't see much hope for the children." "We must adapt ourselves," said Mabel, "or perish. You know—natural selection and all that."

Denis pensively rubbed his scaly chin.

"You mean" he said at length, "that we must grow bigger and tougher, develop thicker hides, stronger claws."

"I *thought* you'd say that," said Mabel. "No, that's just what I *don't* mean. That's what all the others are doing—and look at them ! They are so big that they can scarcely drag themselves about ; their appetites are so enormous that the whole forest is threatened with famine. No, Denis, to survive we must be swift, compact, powerful and versatile. And we must multiply. It is the only way."

"But, surely," said Denis, "your proposals are contrary to the age-old principle that there is safety in bulk."

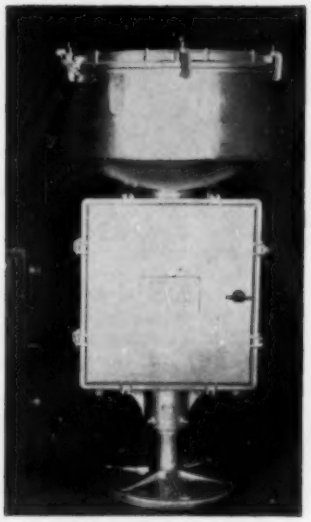
"True. I prefer to think that there is safety in speed and numbers."

Well, as we all know, the pterodactyls, the dinosaurs and so on died out. But what happened to Denis and Mabel and their minosaur offspring has never been discovered. Some authorities claim that they left the forests and colonized the planet Uranus ; others maintain that after millions of years of subtle adaptation to changing climatic, economic and military conditions they became lizards, or penguins or company directors.

We do not know, but the general concensus of opinion is that in some shape or form they did manage to survive.

In pursuance of their firmly held beliefs in matters of twentieth-century defence against air aggression, Folland Aircraft Limited, of Hamble, Hampshire, have undertaken an intensive programme of research, design and prototype development.

FOLLAND



(Left) National Bureau of Standards transmissometer projector installed at the Washington National Airport for measuring visibility along a runway. (Centre) Receiver installed 750ft from the projector. (Right) Fixed-beam ceilometer projector for measuring height of cloud-base above airport.

AIRFIELD VISIBILITY ASSESSMENT

American Experiments with Automatic Observation Equipment

AN extensive programme of research has been conducted since 1951 by the U.S. Weather Bureau, under the sponsorship of the Air Navigation Development Board, in an effort to find means of increasing the frequency and certainty of poor-weather operations at civil airfields.

One of the phases of this programme has been the provision of an accurate means of measuring visibility and ceiling, and for this purpose two types of instrument have been developed, the "transmissometer" and the "ceilometer." The first was designed by the National Bureau of Standards and the second by the U.S. Weather Bureau; both have been tested at the Weather Bureau's headquarters at Washington National Airport. Other devices, including cloud-measuring balloons and the General Electric Company's pulsed-light cloud-range meter, have also been tried. The Sperry Gyroscope Company was asked to conduct a programme of aircraft flight tests at MacArthur Field, N.Y., to evaluate the transmissometer and ceilometer for reporting meteorological conditions to pilots making instrument approaches.

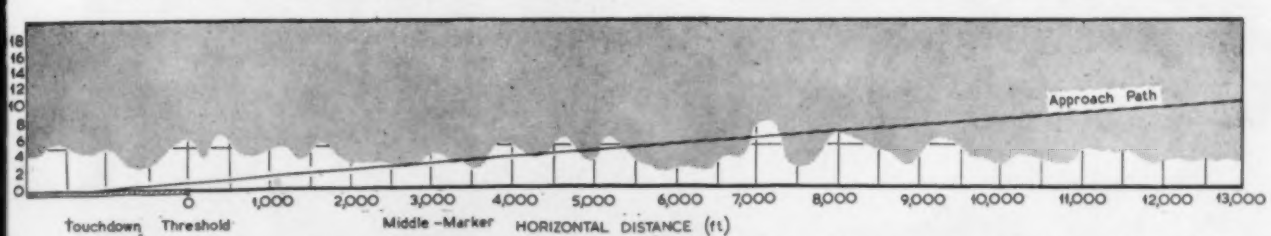
For measuring and recording the visibility along the runway, the transmissometer makes use of a well-established principle. A projector continuously directs a light beam of constant intensity to a receiver consisting of a photo-electric detector equipped with a lens system and a diaphragm for adjusting the amount of light reaching the photo-electric cell. Current generated by light reaching the cell is discharged as pulses through an amplifier and transmitted to the indicator-recorder, which produces a continuous record of readings.

The apparatus is supplemented by a ceilometer, an instrument for measuring height and density of overhanging fog or clouds. One type of ceilometer consists of a vertical light projector, a photo-electric detector which scans its beam, and a recorder. The detector is activated when it receives light reflected by water-droplets where the projector beam enters the base of a cloud. Electrical impulses thus produced in the cell are amplified and relayed to a chart recorder. The detector is placed some distance from the projector and aimed at an angle towards the illuminated spot in the cloud. When it receives maximum reflection, the height of the spot, and hence of the cloud-base, is calculated by simple triangulation.

The projector emits a beam of approximately 20 million peak candle-power, generated in an air-cooled mercury-vapour quartz tube about $1\frac{1}{2}$in long and $\frac{1}{4}$in in diameter. The tube modulates the light beam to a frequency of 120 c.p.s., which the detector can distinguish from other sky illumination and from aircraft landing lights.

The detector is mounted in a pivoted metal tube. An electric motor swings it continuously through an arc from horizontal to vertical and back to scan the light beam once every 12 minutes. When a bright area caused by scattering of the light rays by cloud droplets actuates the photo-electric cell, the current is amplified and sent through a circuit tuned to the frequency of the projector beam; the signal is fed either to a micro-ammeter or to a recorder-amplifier. This signal is then correlated with the angular position of the scanner, and a chart produced showing the height of dense cloud formations.

An important refinement of this device is the rotating-beam ceilometer, developed by the Weather Bureau and tested during the past two years. The projector beam moves up and



Cloud-base contours—a diagram prepared from ceilometer data, and indicating a hypothetical approach path under a minimum ceiling of 200ft.

AIRFIELD VISIBILITY ASSESSMENT . . .

down continuously in the vertical plane, while the detector scans it. Cloud-reflection caused by scattering of the light usually increases to a maximum and then decreases as the projector rotates. The elevation angle of the projector at the time of maximum scattered light shows the height of the most dense part of a cloud. Motors driving the projector and the detector are synchronized so that, as the varying signals from the detector are transmitted continuously to the indicator, they are co-ordinated with the simultaneous angular position of the projector. Thus the recorder produces a chart of cloud density at various heights.

If a power supply is available at the sites of the projector and detector, signals between them and the indicator can be transmitted over two-wire telephone lines, and the projector and detector may be located several miles from the site of the recording indicator.

Tests of the accuracy of the transmissometer and ceilometers are being continued by the Weather Bureau at Washington National Airport, at the Silver Hill Observatory a few miles away, and by the Sperry Gyroscope Company at MacArthur Field. Results already obtained, however, have been so encouraging that the Air Navigation Development Board has decided to install such instruments next October at the International, La Guardia, and Newark, N.J., airports serving New York City.

By last autumn, Sperry pilots had made more than 150 landings with a Dakota at MacArthur Field under ceilings of less than 800ft; use of information gained by the new equipment, instead of that obtained by conventional methods of assessment, reduced the proportion of missed approaches by 50 per cent through accurate cloud base information.

RANGER OF THE NORTHLANDS: THE AVRO CANADA CF-100

AVRO CANADA CF-100s, Mks 1, 2 and 3, are already in service with R.C.A.F. all-weather fighter units in Canada, and Mk 4s are now coming off the production line at Malton, Ontario. In contrast with earlier versions, the Mk 4 is armed with 2.75in Mighty Mouse rockets—a cluster of 29 at each wing tip and a retractable tray holding 48 under the fuselage. The wing-tip containers, just visible in the magnificent photograph below, are made of light alloy, with nose- and tailcones of unpainted fibreglass. Immediately before the rockets are fired the tailcone is jettisoned and the missiles then break through the nosecone; finally, the light-alloy cylinder is jettisonable, allowing some 20 deg/sec increase in rate of roll. Alternatively to the Mighty Mice the under-fuselage tray can accommodate 8×0.5in or 4×30 mm guns.

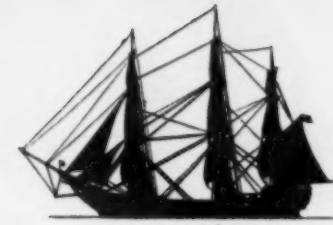
A point of particular interest is that about 30 per cent of the total lift of the CF-100 is derived from the centre section and engine nacelles. The new "blunt" radar nosecap and antenna, supplied by Hughes Aircraft Co. of California, is easily mounted on, and detached from, the airframe. Another feature of the Mk 4 is the fitting of wind-driven de-icing fluid slinger vanes at the intakes; the spray from these keeps the intake-guard grilles free of ice.

It will be remembered that the CF-100 Mk 4 has exceeded Mach 1 in a dive.

Extensive trials are now in hand to prove the Mk 4 for operation under extreme climatic conditions. The rocket armament is also undergoing final tests. Over 30 production Mk 4s have already left the line and the variant will enter service as soon as tests are completed.

Tenderfoot no longer, the CF-100 Mk 4 is in volume production for the R.C.A.F.

Air Power at Sea



H.M.S. OCEAN

An 80 gun French warship, captured in 1769, was immediately re-named *H.M.S Ocean*, but being found crippled and unseaworthy her captors destroyed her by fire without delay.

The 5th ship of the same name is the Light Fleet Carrier, commissioned in 1945. *Ocean* completed two tours of duty in Korea. The Boyd Trophy, awarded annually for the most outstanding feat of aviation in the Navy, was won by Squadrons 802 and 805 embarked in *Ocean* in 1952. In 79 days of flying the average daily sortie rate was 76.3. Before her foreign service, this already famous ship was one of the Navy's principal trials carriers: she was the first British ship to fly off jet aircraft, heralding the conversion of the Fleet Air Arm to turbine-powered aircraft such as the anti-submarine Fairey Gannet.

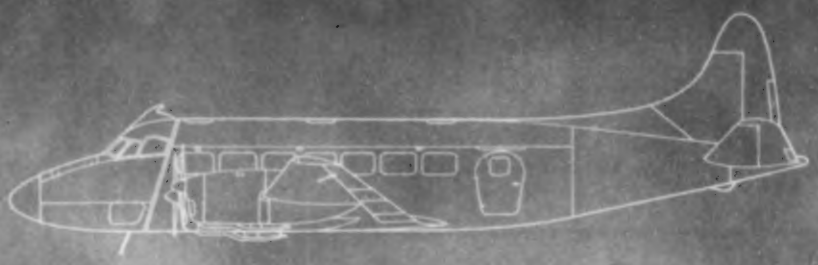
Crown copyright of the badge of H.M.S. Ocean *is reserved and reproduction is made by permission of the Admiralty and H.M. Stationery Office.*

FAIREY

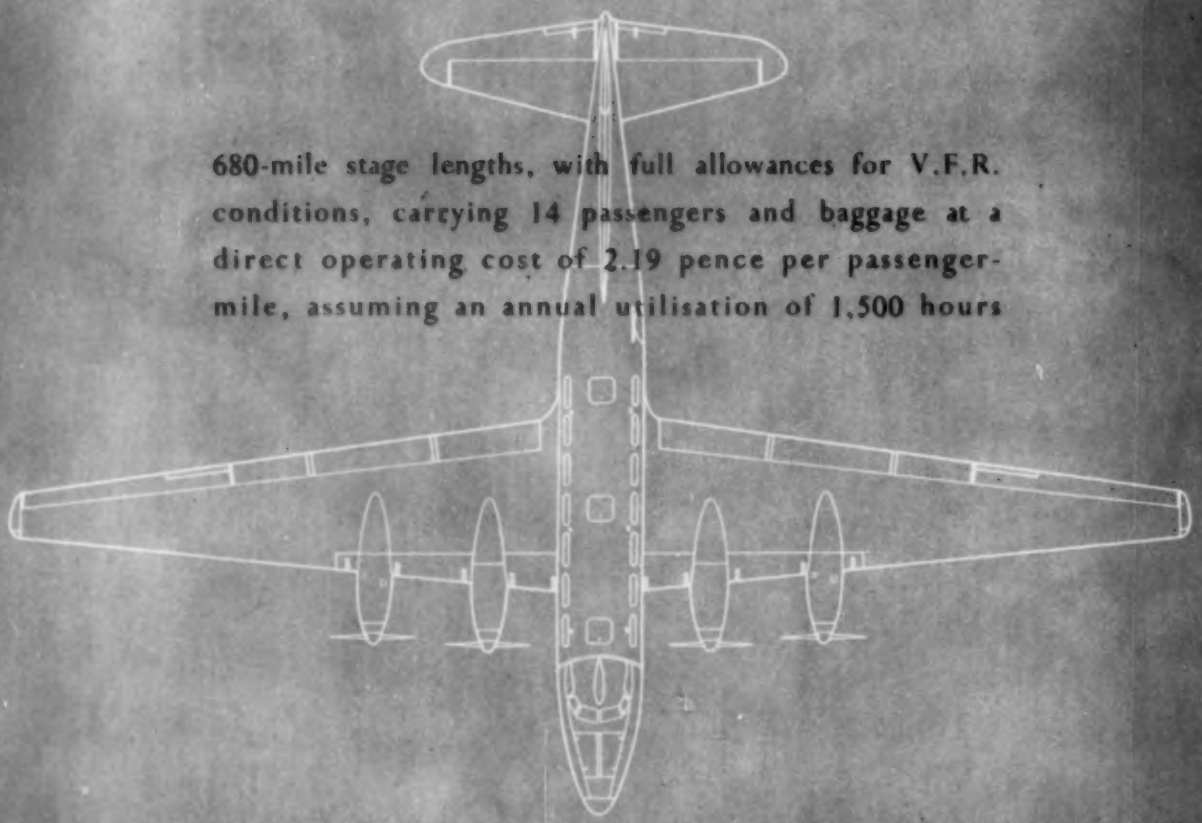
Powered by an Armstrong Siddeley "Double Mamba"

GANNET

THE FAIREY AVIATION COMPANY LIMITED · HAYES · MIDDLESEX



Frequency and economy
in branch-line traffic

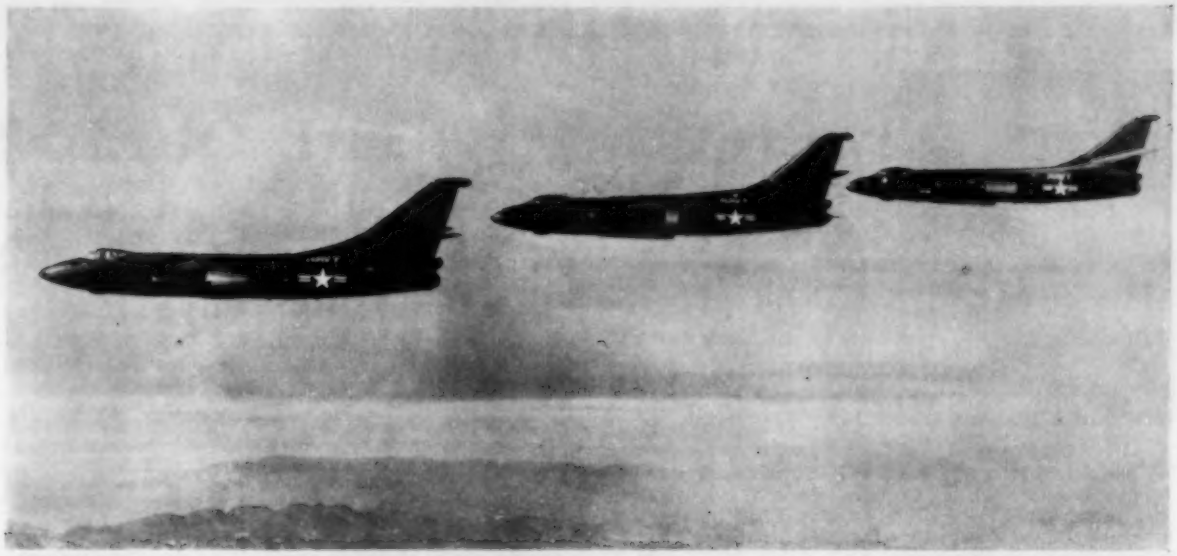


680-mile stage lengths, with full allowances for V.F.R. conditions, carrying 14 passengers and baggage at a direct operating cost of 2.19 pence per passenger-mile, assuming an annual utilisation of 1,500 hours

DE HAVILLAND HERON SERIES 2

with retractable undercarriage

(Four de Havilland Gipsy Queen 30 Mark 2 engines, each 250 b.h.p., driving de Havilland two-blade, variable pitch, non-feathering propellers)



SKYWARRIORS: Under the noble name Skywarrior, the Douglas A3D twin-jet bomber—claimed to be the most formidable attack machine ever designed for carrier use—is now in production for the U.S. Navy. The leading AD3 here is a production machine, the J57 nacelles contrasting with the J40 pods of the prototypes. It will be noted that the centre machine has its remotely-controlled tail guns installed. The Skywarrior was designed to operate from carriers at present in use as well as from the Forrestal class "super carriers" (the world's largest) now under construction.

AIRCRAFT INTELLIGENCE

Great Britain

Engine Test-Beds. Five new or revised test-beds are on the point of beginning flight trials. They are a prototype Airspeed Ambassador re-engined with Proteus 705s, which is about to be used by the Bristol Engine Division to work out all kinds of installation problems, such as de-icing; the lone Marathon 2 (formerly powered by two Mambas) which will test the Leonides Major; a production Varsity, fitted with two Napier Elands; a production Shackleton, in which the outer Griffons have been replaced by Napier Nomads (driving single airscrews instead of contra-props. as formerly) and Armstrong Siddeley's Dakota, about to air-test the Mamba 6.

U.S.A.

Republic F-84F and XF-84H. The transonic, Sapphire-powered Thunderstreak is now entering U.S.A.F. service: the first two units are the 27th and 506th Strategic Fighter wings (based in Texas and Maine, respectively) which are part of Strategic Air Command. It is also learned that the first experimental XF-84H has been completed and has been "trucked" across country to Edwards A.F.B., California. This Thunderstreak has a "t-tail" and an Allison T54 double turboprop in the nose, driving a supersonic airscrew. The craft will be used for general development of high-speed turboprops and airscrews.

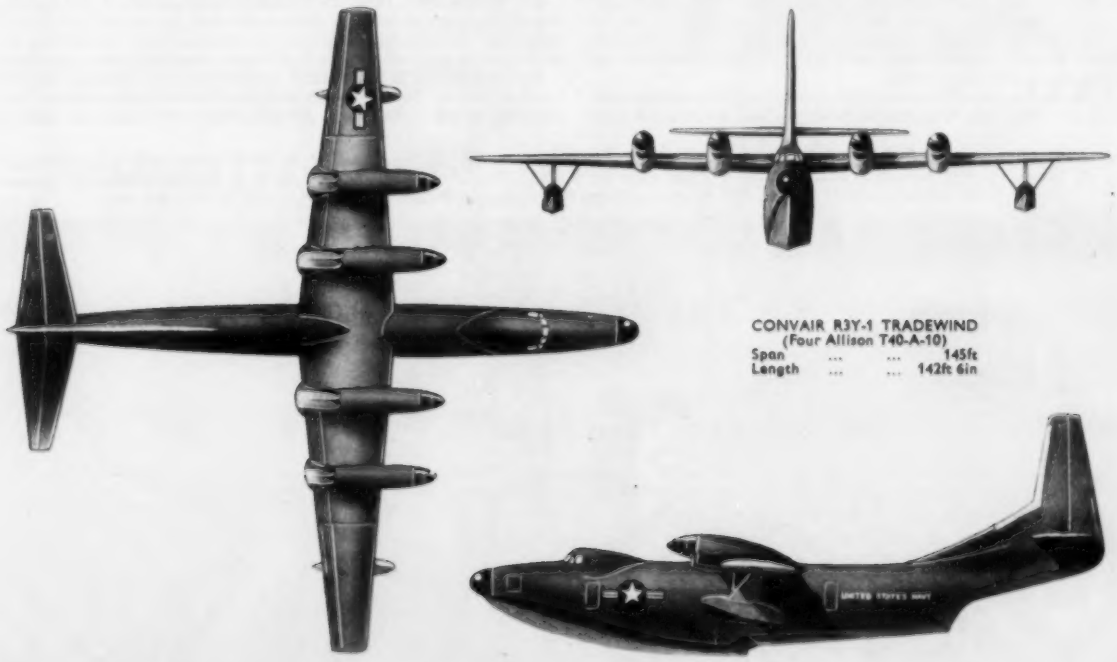
McDonnell Demon. One of five transonic carrier-based fighters now entering U.S. Navy service, the McDonnell F3H Demon is characterized by an internal tankage of some 1,000 gallons, giving it exceptional range. Only about 60 are being delivered powered by an afterburning Westinghouse J40 (the original engine), the standard engine for later deliveries being the Allison J71-A-2 of 14,000 lb thrust. The first production series include the F3H-1N and 2N all-weather fighters, the F3H-2M missile launcher and the F3H-2P reconnaissance machine with an extended camera nose.

Italy

*S.A.I. SM.*132. It is reported that the S.A.I. Marchetti company have an "executive transport" project, which has been submitted to the Italian Government. Powered by two Avon RA.3s (these are military engines) the design specifies a cruising speed of 500 m.p.h. and a range of approximately 800 miles with 24 passengers.

Spain

Messerschmitt Fighter. It is reported that Willy Messerschmitt, the German aircraft designer, now working in Spain, has "a jet fighter" on the drawing-board.



CONVAIR R3Y-1 TRADEWIND
(Four Allison T40-A-10)

Span	145ft
Length	142ft 6in

Training Aircraft
1925—1936
←

Operational Aircraft
1925—1942
→

THE QUEEN'S S

A HISTORY OF No. 603 (CI SQUADRON, ROYAL AUXI

By JOHN YOXALL

TO No. 603 (City of Edinburgh) Squadron is accorded the honour of having Queen Elizabeth as Honorary Air Commodore. Her Majesty accepted the appointment before coming to the throne; after her accession it was her express wish that it should remain.

About the very early days of No. 603 Squadron little information is available, but there is no question that it started in October 1925 with an establishment of 23 officers and 158 airmen. The aircraft were D.H. 9As with Avro 504s for training purposes. In those days the Auxiliary squadrons taught their new pilots from the *ab initio* stage. S/L. J. A. McKelvie, A.F.C. was the first commanding officer.

The beginning was very modest. On the 10th of the following April, when No. 603 was inspected by the Chief of the Air Staff, Air Chief Marshal Sir Hugh (now Marshal of the R.A.F. Lord) Trenchard, there were on parade the C.O., two flying officers, 55 airmen, two D.H.9As and three Avros. By the end of 1926 the strength of the Auxiliary personnel was four officers and 71 airmen; one rotary-engined Avro 504K had been replaced by a 504N with Lynx engine. There was, however, a gradual build-up.

An interesting posting at the time was that of F/L. H. S. P. Walmsley, M.C., D.F.C., who recently retired from the Service as Air Marshal Sir Hugh P. Walmsley, K.C.B., K.C.I.E., C.B.E., M.C., D.F.C., and who is now managing director of Air Service Training, Ltd. He had as his assistant adjutant P/O. Lord Malcolm Douglas-Hamilton.

In 1930 the war-time D.H.9As were exchanged for Westland Wapitis, but the Lynx-Avro remained as the training type.

Each year the unit went from its base at Turnhouse—where it is today—to Leuchars for summer camp. Each year, also, a flight from one of the regular fighter squadrons was affiliated for practice; in 1931 this flight came from No. 19 Squadron.

While No. 19 were in residence, Turnhouse was visited by the Prince of Wales, later King Edward VIII, and the Earl of Stair, the unit's first Honorary Air Commodore. During the same year (1931) there was a change in command; S/L. McKelvie retired and S/L. H. R. Murray-Philipson took over. Lord Douglas-Hamilton retired from the regular R.A.F. but remained with the squadron as an Auxiliary officer.

S/L. H. R. Murray-Philipson was a successful businessman who lived in the Muirfoot hills near Peebles. Here he had his own airfield and kept his private D.H. Moth. His grounds were sufficiently extensive for him to provide No. 603 with their own bombing range and he used to persuade the Territorial Royal Engineers to camp there and mark the bombing practice of the squadron.

By 1932 the summer camp was more ambitious; it was held at Manston in Kent, and while there the unit took part in the A.D.G.B. (Air Defence of Great Britain) exercises.

Another change of aircraft came in 1934, when Hawker Harts replaced the Westland Wapitis. Some Avros were still on strength, and D.H. Moths were also used, until they were all replaced by Avro Tutors in 1936.

In these days of global bombers it is interesting to note that when, in March 1934, No. 603 flew down from Scotland to Hendon to take part in a concentration of Auxiliary squadrons a refuelling stop had to be made at Usworth. The return journey, the squadron diary proudly relates, was made without a stop.

S/L. Murray-Philipson, who had done so much for the unit, had to give up owing to ill-health—he died shortly afterwards—and on April 1st, 1934, his place was taken by Lord G. N. Douglas-Hamilton.

And so peace-time life went on, with summer camps, affiliation exercises, garden parties—one at Holyrood House—and Empire Air Days. A high-spot was the sending of a party of one officer and ten airmen to London for the coronation of King George VI.

Early in 1938 the Harts gave place to Hinds—a development of the Hart in which, among other differences, a Rolls-Royce fully supercharged Kestrel V of 600 h.p. replaced the 480 h.p. Kestrel IB; and No. 603 was transferred from No. 6 (Aux.) Group in Bomber Command to No. 12 Group in Fighter Command.

The Hinds, however, did not stay long, for by March 1939 they had been replaced by Gloster Gladiators, which came from No. 54 Squadron, then stationed at Hornchurch. The transfer from Bomber Command to Fighter Command had not affected the unit's efficiency, for on April 15th, 1939, the squadron diary records the presentation of the Esher Trophy by the A.O.C-in-C. Fighter Command, Air Chief Marshal Sir Hugh (now Lord) Dowding.

On August 23rd, 1939, the squadron was embodied. Following the declaration of war on September 3rd no immediate attack came; the odd patrol was flown, but most of the time was spent in practising on the Spitfires, which were now arriving in numbers.

On October 16th came great excitement: 12 German aircraft made a raid on Naval vessels near the Forth Bridge, where they dropped some 40 bombs. No. 603 intercepted and red section

The squadron officers with a D.H. 9A in 1928. Left to right: P/O. R. I. Kynaston, P/O. A. H. Bruce, P/O. S. M. Musgrave, P/O. I. S. C. Watson, P/O. J. M. Fosbrooke, P/O. J. L. Jack, M.C., F/L. C. R. Keary (Adjutant), S/L. J. A. McKelvie, A.F.C., Rev. W. B. C. Buchanan, F/L. V. B. Bennett, (Assistant Adjutant), F/O. T. Usher, P/O. M. H. G. White, P/O. A. M. Mitchell, P/O. A. Wallace, P/O. E. S. V. Burton.

QUADRON

(OF EDINBURGH)

ARY AIR FORCE

Part I

under F/L. P. Gifford shot down a Heinkel 111 into the sea off Port Seton. Three crew-members were rescued and taken prisoner. Yellow section, under F/L. G. L. Denholm, pursued another Heinkel out to sea. P/O. Gilroy's Spitfire was the only machine to suffer damage—it received one bullet through the top engine cowling. The bodies of two German airmen killed in this action were buried with military honours, the squadron pipe band attending in full-dress uniform.

Six days later F/L. Gifford's red section had a further success by shooting down a Heinkel 111 which attacked a convoy off St. Abb's Head; and again it was the same section, joining forces with another from No. 602 (City of Glasgow) Squadron, that shot down the first enemy aircraft actually to fall in Britain—the others had fallen in the sea. An account of the fight says: "One enemy aircraft was sighted by a patrol of No. 602 Squadron and Red Section of No. 603. It was revealed by anti-aircraft shell bursts. No. 602 Squadron attacked first, followed by No. 603, and the e/a, which proved to be a Heinkel 111, was shot down near Kidlaw, six miles south of Haddington. Two of the crew were dead, the pilot wounded and the observer unhurt. The two squadrons were each credited with a half share.

A month later F/L. Gifford left the squadron in order to take over command of No. 3 Fighter Squadron. He was awarded the D.F.C. for his work with No. 603. A move made from Turnhouse to Prestwick was indeterminate, for in January 1940, a further move was made to Dyce.

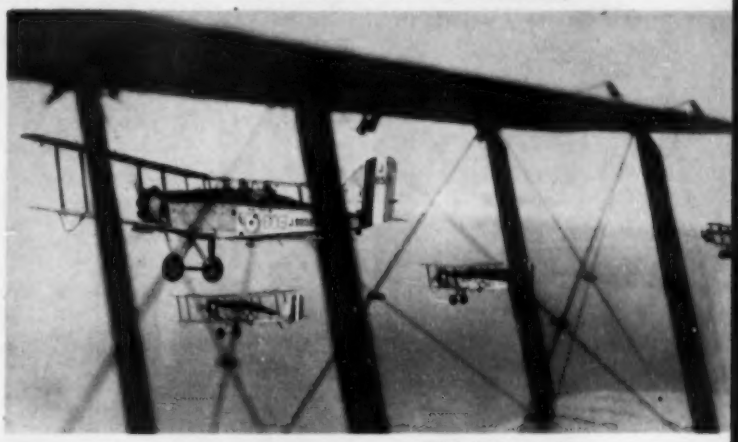
Almost immediately on arrival at Dyce the squadron scored a further success. A section under F/O. H. K. Macdonald recognized a Heinkel 111 20 miles east of Aberdeen and attacked, opening fire at 350 yd and closing to 200 yd. The enemy made no effort to jink, neither was there any return fire. Contrails were a novelty then and it is interesting to read that "the intense cloud trail created by the Heinkel made observation very easy but obscured it from astern. . . . When coming up behind the Heinkel the Spitfire was caught in the cloud formed by the enemy aircraft which froze to the windscreen." Intense cold caused gun failures, but the Heinkel was last seen going down on to the sea and was later confirmed as destroyed.

"Bandits" became scarce but operational patrols were still flown; for a while they were known as "co-operational practice." Then affairs quietened down for what was later to become known as the "phoney war." At the end of May 1940, W/C. Broadhurst (now Air Marshal Sir Harry Broadhurst, C-in-C. 2nd T.A.F.) lectured to the pilots on fighter tactics in France. Yet up north the war was never really "phoney." In June Turnhouse was raided and 603 bought down two of the attacking aircraft; and in the first week of July two Ju 88s and a Heinkel were added to the bag. July, in fact, proved to be a very busy month; no fewer than ten enemy aircraft, all definitely confirmed, fell to the guns of the squadron Spitfires.

However busy July appeared, August was much more so. Detachments which had been at Dyce and Montrose returned to the unit at Turnhouse. Immediately came the order for all flying personnel and 32 ground crew to proceed to Hornchurch—the Battle of Britain was on. Within three days of their arrival four pilots were missing and three more were wounded. Sgt. Sarre came back on the morning of the 30th with the tail of his aircraft almost shot away and in the afternoon of the same day he baled out when his tail was completely shot off. Three other members of the squadron had to bale out. But the Germans had to pay a price; over the same period the squadron claimed 25 enemy aircraft destroyed and a further 11 probables.

It was a time for heroic deeds but not, apparently, for heroic writing. The squadron diary of the time is positively laconic. "1-9-40 Fighting patrols. F/O. R. McG. Waterson reported killed. P/O. G. K. Gilroy parachuted from burning aircraft and was badly treated by Home Guard (lynching threatened). P/O. P. M. Cardell forced landed. P/O. J. R. Caister returned from leave (honeymoon). 2-9-40. Fighting patrols. F/O. J. G. E. Haig landed with undercarriage retracted, due to enemy action. Sgt. J. Stokoe missing. . . . 3-9-40. Fighting patrols. P/O. D. Stewart-Clark parachuted from disabled Spitfire and taken to hospital (wounded). P/O. R. H. Hillary parachuted from burning aircraft into channel and picked up by the Margate lifeboat and taken to hospital. 4-9-40. Fighting patrols. Sgt. A. R. Sarre force-landed at Ashford (uninjured). 5-9-40. Fighting patrols. F/L. F. W. Rushmer missing from patrol. P/O. W. P. H. Rafter missing. F/O. I. S. Ritchie discharged from hospital. 6-9-40. Fighting patrols. P/O. J. R. Caister missing. . . ."

And so it went on day after day—not (as is usual in army or naval warfare, where a face-to-face encounter is a rare occurrence)



"Flight" photograph

A formation of 603 Squadron Westland Wapitis, photographed by the author 22 years ago.

An informal group of officers in 1932. From left to right are: P/O. P. Gifford, F/O. T. M. McNeil, F/O. A. M .Mitchell, Mr. G. Gatturall, P/Os. E. H. Stevens, I. D. Shields, F/O. D. M. T. MacDonald, F/O. C. H. W. Bolders, P/Os. G. A. Reid, I. Kirkpatrick, F/L. I. E. C. Watson, F/O. A. Wallace, S/L. H. R. Murray-Phillipson, C.O., F/L. J. Jack, M.C., F/L. R. Legg.

"Flight" photograph

Fighter affiliation in 1935: The Gauntlets of No. 19 Squadron on the tails of 603 Hawker Harts. (Right) Rearward camera-gun practice on a Hawker Hart in 1935. "Flight" photographs

Pilots of the squadron in August 1941: Back row: Sgt. Plt. G. P. Stone, P/O. N. H. C. Keable, Sgt. Plt. D. F. Ruchwaldy, F/O. R. V. L. Griffiths and P/O. R. G. Marland. Centre: P/O. A. R. Falconer and F/L. F. D. S. Scott-Malden. Front row: P/O. G. Fawkes, Sgt. Plt. W. J. Archibald and F/O. H. G. Niven.

P/O. "Hamish" Faulkner just after being retrieved from the Channel in August 1941. (Right) A formation of No. 603 Squadron Spitfires at Dyce, 1941.

THE QUEEN'S SQUADRON . . .

flying in the face of the enemy once, but several times each day.

On September 11th the remainder of the unit travelled down by special train from Turnhouse to Hornchurch to rejoin the squadron which, because of casualties and postings, was already beginning to lose its familiar outline. At the end of the month the C.O., S/L. E. H. Stevens, left Hornchurch to command Ford.

All through October and November No. 603 stayed in the battle, making the enemy pay very dearly for the casualties sustained. Sgt. Plant was lost by actually colliding with an He 111 over Faversham, and the unit was one of those which tried conclusions with one of the fighter raids made by the Italians. Intercepting the enemy over Dover, the squadron attacked from astern. Of the 20 C.R.42s in the formation, two each fell to P/O. Winskill and Sgt. Darling; one each was shot down by P/O. Macnamara, F/O. Pinckney and P/O. Berry, and the last-named also claimed a probable; F/L. Boulter claimed a probable, and P/O. Scott-Malden two damaged.

On December 14th No. 603 was withdrawn from the battle and went back north, to be stationed at Drem on the Firth of Forth. Even here there was no remission, and on Christmas Day F/O. B. G. Carbury, leading blue section, saw and attacked a Ju 88 at 1,000ft about 12 miles N.E. of St. Abb's Head. Its undercarriage dropped and its starboard engine stopped, but only a "damaged" was claimed. This was the last fight until the following May. S/L. Denholm, who had taken over after S/L. Stevens' posting, left the squadron to go to Turnhouse and command went to S/L. F. M. Smith, who came from No. 72 Squadron.

All remained quiet until orders came for the squadron to return to Hornchurch on May 16th, 1941. On that day two Ferry Flight Harrows* left with 40 n.c.os and men on board, 13 pilots flew their Spitfires down, and a rail party left Edinburgh.

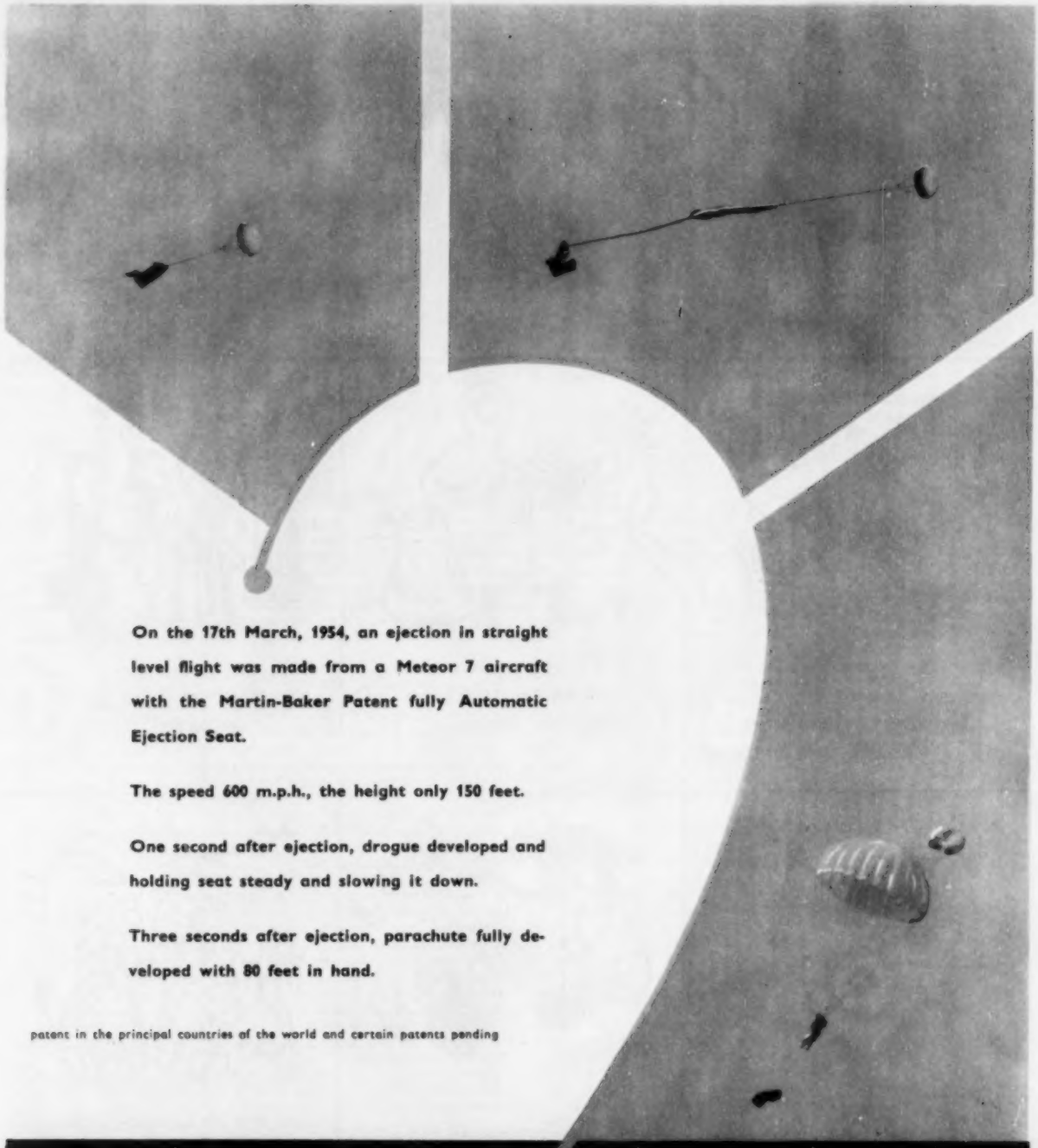
Within two days the squadron was carrying out fighter sweeps over occupied France and escorting day-raiding bombers. The first of these operations was flown by five sections, over the Dunkirk, Calais, Boulogne areas. Usually operating with Nos. 54 and 611 (West Lancashire), No. 603 usually put up about 12 aircraft for these fighter sweeps but the Luftwaffe was very wary about trying conclusions. It has since been established that our claims for enemy aircraft shot down in the Battle of Britain were exaggerated but, nevertheless, the Germans took a severe pounding. Every day at least one sweep was flown by No. 603 but the pilots seldom saw more than five Me 109s at one time.

On June 16th, 1941, a short move was made from Hornchurch to Rochford, near Southend, and the same operational work went on. During the month five enemy aircraft were claimed as destroyed; Sgt. Salt was posted missing. The Mk II Spitfires had been superseded by the Mk 5a.

During July the fighting became more exciting; the squadron was now forming part of the Target Support Wing, whose main

**It is more probable that these were "Sparrows," i.e., Harrows with turrets removed.*

Some squadron pilots at Dyce in 1941. In the centre is S/L. Lord David Douglas-Hamilton and second from the left is F/L. W. Douglas, "A" Flight Commander, who also flew with No. 603 at Coltishall in 1945, as Wing Commander Flying. (Right) Air Chief Marshal Sir Charles Portal and Air Marshal Sir Keith Park, A.O.C. Malta, chatting with 603 Squadron fighter pilots during the Battle of Malta.



On the 17th March, 1954, an ejection in straight level flight was made from a Meteor 7 aircraft with the Martin-Baker Patent fully Automatic Ejection Seat.

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Three of the squadron's tropicalized Spitfires on the airfield at Takali, Malta, in 1942.

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task was to protect the new Short Stirlings on daylight raids over occupied territory. These raids stung the Germans into action. On the 8th, for instance, 15 Me 109s attacked near Hazebrouck. F/L. Scott-Malden fired at one of a pair and hit its radiator. Sgt. Wood was hit by flak over Calais and chased across the Channel by a 109; but when the Messerschmitt turned for home he turned to attack. His bullets ripped open the enemy's fuselage and he had the satisfaction of seeing his quarry hit the water. Wood, slightly wounded, crash-landed near Canterbury. Blue section tried conclusions with three Me 109s but without conclusive results.

Again the same day, this time over Lille, 15 Me 109s attacked the squadron. On this occasion Sgt. Tabor got two—the second of which came at him head-on; he fired one burst and saw the Me crash straight into a tree.

Having started this day at 0545 and finished flying at 1630 the squadron had then to move from Rochford back to Hornchurch. In the squadron diary there is no complaint about the operational flying but there *is* one about the bother of shifting of files, documents and furniture. . . .

Lille seemed to be a frequent target for the Stirlings and for one such attack—on July 19th, 1941—G/C. Broadhurst led eleven Spitfires of No. 603 Squadron as escort cover wing.

Tails were certainly well up. On the 21st another operation over Lille was flown, led this time by W/C. Stapleton. Over the target a dog-fight ensued with 15 Me 109s, in which P/O. J. De Lorme got one, the wing commander another and Sgt. Archibald damaged a third. Sgt. Tabor, returning at nought feet, destroyed a 109 standing on St. Omer airfield, shot a man off an anti-aircraft watch-tower and attacked a ship. De Lorme was lost the next day.

The enemy were met in greatest force on July 23rd, when eight aircraft from the squadron were top cover to a bomber formation over Bethune. Crossing the coast at 18,000ft near Le Touquet one Spitfire had to turn back because of an oil leak and another because its hood was shot off. Almost immediately the remaining six aircraft were jumped by 20 Me 109s. A dog-fight developed and enemy aircraft appeared from all directions. Sgt. Tabor was lost, but F/L. Gilroy and Sgts. Store and Neill reached the target and came back with No. 611 Squadron. All the bombers were hit, but all got safely back.

The next day S/L. F. M. Smith left the squadron and became one of the station H.Q. staff at Hornchurch; his going was much regretted. S/L. M. J. Louden from No. 242 Squadron, took over command. Another loss to the squadron the same month was the departure of F/L. G. K. Gilroy, D.F.C.—better known as "Sheep" Gilroy—who was posted to command No. 609 (West Riding) Squadron, A.A.F., at Gravesend.

August 1941 was another month of offensive sweeps and bomber escorts. On an escort operation the C.O. was wounded and his Spitfire was very badly damaged, but he managed to get home. While on high cover at 28,000ft, well inside France, P/O. Falconer's aircraft was hit and its pilot was wounded. Making for Dover, he got within two miles of the coast before hitting the water. Three soldiers swam out to rescue him but one had to turn back. The others, Ptes. Worthington and Carter of the Royal West Kent Regiment, both reached him. All three were very near complete exhaustion when a rescue boat from North Foreland picked them up.

The affairs of earlier members of a squadron are always of interest. On September 2nd, the diary notes, F/L. J. S. Morton arrived, pending posting for training as a controller. Morton was with No. 603 from before the outbreak of war until he was shot down in October 1940. He was officially credited with four e/a. destroyed, five probables and five damaged.

September was yet another month of bomber escorts and sweeps over occupied territory. Flying was curtailed a little by fog but nearly every day 12 aircraft from No. 603 would join the Hornchurch wing for operations.

Frequently it was difficult to stir up any activity, but on the 27th the enemy responded very sharply. Twelve of the squadron's Spitfires were acting as close escort to 12 Blenheims attacking Mazengarbe. The crossing of the French Coast at 17,000ft was accompanied by heavy and accurate flak. A dog-fight developed in which claims were made for one Me 109 destroyed, two probables and one damaged. Sgts. Allard and Archibald were both missing; P/O. Marland force-landed on the beach at Dungeness; Sgt. Bennett crash-landed at Lympne; and Sgt. McKelvie's rudder was shot away and his tailplane damaged, but he managed to struggle back to base.

October opened with a Channel sweep by the Hornchurch wing led by G/C. Broadhurst. On the return journey the Luftwaffe attacked. One Messerschmitt tried to jump G/C. Broadhurst but was, in its turn, attacked by the group captain and P/O. Falconer, who was his No. 2. The enemy fell to Broadhurst's guns.

A change in command came on the 16th, when S/L. Louden left to go to Libya for special duties. S/L. Forshaw took over.

There was an unfortunate occurrence on the 21st when P/O. Fawkes and Sgt. McKelvie collided about five miles south of Calais. The sergeant was last heard to say he was baling out, but Fawkes, despite the loss of nearly four feet from one wing-tip, was able to make a successful landing at Lympne.

On the last day of October the squadron forsook its high-flying rôle to join with No. 611 Squadron in escorting Hurricane bombers to attack a power station at Holquer. The outward and inward journeys were both flown at 300ft, rising to 1,000ft while over France. It was a lively attack; barges in the canals were shot up —some were sunk—goods trains were attacked, and a warehouse was completely destroyed.

November 1941 lived up to its reputation for bad weather and the most stimulating occurrence appears to have been a housewarming party at which a number of eightsome reels were danced. One of the pipers was F/L. Lord Douglas-Hamilton.

On December 8th contact was made for the first time with Focke-Wulf Fw 190s in a sharp fight over Hesden. For this engagement No. 603 were middle cover but became detached and were outnumbered. Three pilots failed to return.

Later in the month, on the 15th, a move was made back home to Dyce, and very glad the squadron was to get back to the clean cold Scottish air after the fog and soot of the London area. On the first operational flight from Dyce the C.O., S/L. Forshaw was lost. He took off to intercept an enemy night raider reported off the coast; but after a few minutes—with no firing heard—his R/T suddenly stopped and nothing more was heard or seen of his aircraft. S/L. Lord D. Douglas-Hamilton assumed command.

It was obvious that the posting to Dyce was intended to be in the nature of a squadron rest. Operationally this was so, but not in other respects; blizzards raged for days at a time and the whole squadron was engaged in clearing snowdrifts. All ground transport came to a standstill.

Early February brought more snow, yet this saved at least one man's life. Lt. Landsten, a Norwegian attached to No. 603 from No. 331 for night flying, had a gun panel blow off while flying, putting his stalling speed up in the neighbourhood of 140 m.p.h. He came in at about 160 m.p.h. to make a wheels-up landing and

THE QUEEN'S SQUADRON . . .

finished in a snow bank; the aircraft was badly damaged but its pilot escaped with only slight bruises.

Practice at this time was very varied. Everything was covered, from night interceptions to army co-operation with the 51st Highland Division. The main pre-occupation was with a number of attempts—unsuccessful—to get "Weather Willie"—a Ju 88 which came over on most days to within 60 to 100 miles of the Scottish coast to report on weather conditions.

In March the squadron was withdrawn from operations entirely and in the middle of April embarked on the Clyde to go to the Middle East. The ground crews went direct to Kasfareet, Egypt, where they arrived on June 4th. For the aircrews, however, there was a change of plans. They, with their Spitfires, were embarked at Gibraltar in the U.S. carrier *Wasp* and taken into the western Mediterranean from where they flew off and landed in Malta to re-inforce the heavily engaged fighter units on the island. A curious feature of this split-up of the squadron was that the unit number remained with the ground crews. This was because, at that time, Auxiliary Air Force personnel could not be posted from their unit.

Because of casualties and postings, of the original pilots of the squadron there were only two left, the C.O. and F/L. W. A. Douglas. The latter retired as a Wing Commander and still keeps in touch with No. 603.

The Battle of Malta has been described many times. Fighting each day against very heavy odds, it was for some of the pilots a Battle of Britain all over again. But even under such extreme circumstances there was occasionally a lighter side. One such incident concerned the acquiring of an Italian seaplane to use for air/sea rescue work.

A section of No. 603 was scrambled to intercept a Cant 506—a not very aggressive type—but no chances were taken. Two squirts of cannon fire across the wings were sufficient to make it promptly alight on the water a mile off shore, some of the occupants scrambling out on the wing waving white shirts. A launch towed it in.

Investigation revealed nine people on board—five, the original Italian owners and four, the crew of an R.A.F. Beaufort which had been shot down and were being transported to prison camp. Apparently there had been a small battle in the Cant during which the R.A.F. took over from the Regia Aeronautica. When the Spits attacked, however, they dumped the Italian pilot back in his seat and made him bring the Cant down on to the water. A happy ending to the story is that the Beaufort crew were all awarded the D.F.C.

No. 603 fought on into July and August, the fighting reaching peaks of intensity when ship convoys attempted to reach the island. Gradually reinforcements came in and the Luftwaffe had to admit another major defeat. The few remaining pilots of No. 603 were posted to No. 299 Squadron on its formation at Takali on August 3rd.

(To be concluded)

COMMANDING OFFICERS

S/L. J. A. McKelvie, A.F.C.	1925	W/C. J. R. H. Lewis, D.F.C.	11-43
S/L. H. R. Murray-Philipson	1931	W/C. J. D. T. Revell ...	15-6-44
S/L. Lord G. N. Douglas-Hamilton	1-4-34	W/C. C. N. Foxley-Norris...	23-9-44
S/L. E. H. Stevens	23-8-39	S/L. Patterson, D.F.C. ...	10-1-45
S/L. G. L. Denholm, D.F.C.	29-9-40	S/L. T. C. Rigler, D.F.C., D.F.M.	26-1-45
S/L. F. M. Smith	1-4-41	S/L. H. R. P. Partwee, D.F.C.	1-4-45
S/L. M. J. Louden	7-7-41	S/L. G. K. Gilroy*, D.S.O.,	
S/L. Forshaw	19-10-41	D.F.C.	11-6-46
S/L. Lord D. Douglas-Hamilton...	19-12-41	S/L. J. W. E. Holmes, D.F.C., A.F.C.	23-9-49
S/L. P. Illingworth	10-4-42	S/L. P. J. Anson, D.F.C. ...	1-12-50
S/L. Marshall	8-42	S/L. R. Lloyd Davies, D.F.C.	22-3-53
W/C. H. A. Chater... ...	28-1-43	S/L. R. A. Schofield... ...	25-8-53

*War-time group captain.

CANADAIR DELIVERIES

A RECORD number of jet aircraft was accepted by the Royal Canadian Air Force from Canadair, Ltd., during March. The total was 146, practically enough (the makers point out) to re-equip all the Canadian squadrons flying with the NATO forces in England and Europe. The break-down is: 64 North American F-86 jet fighters, 73 Lockheed T-33 jet trainers, and nine overhauls. The Sabres, incidentally, required 160 flights by Canadair test pilots.

The previous record was established in February, when the company cleared just under 90 aircraft for the R.C.A.F. The abnormal "back-log" in March was due to bad flying-weather during the early months of the winter.

Most of the T-33 jet trainers, incidentally, are going to R.C.A.F. stations in the western provinces because of the almost constant good flying weather on the Prairies. Until very recently most of them had been based in Eastern Canada. Stations concerned in the new deployment are MacDonald, Gimli and Portage la Prairie.

"TRAINING" A PILOTLESS DRONE

TO meet an urgent requirement for a high-speed, pilotless, target "drone," the development programme of the Ryan Firebee has been accelerated. While the company's technicians are still carrying out production development at the Holloman Air Development Centre near White Sands, New Mexico, a U.S.A.F. detachment of 17 men of the 3225th Drone Squadron of the 3205th Drone Group have already begun operational suitability tests at the same base. The Ryan team is concerned with the development of the Firebee for production; the 3225th Squadron, on the other hand, is carrying out a series of exercises to establish the service operating techniques for the machine.

Most of the squadron personnel have undergone an eight-week training course on the structure, assembly, operation and recovery of the Firebee, and they are now laying out a basic operating technique. Whereas the Ryan group mainly employs rocket-assisted ramp launching, the Drone Squadron uses a B-26 for ground-controlled air drops. At first the B-26 carried a Firebee under one wing and a compensating water-ballast tank under the other. It was then decided that time could be saved by carrying two Firebees and making two launches for every B-26 take-off.

The airborne routine is as follows: the B-26 takes off and climbs to its launching height on a rectangular course. While carried by the aircraft, the Firebee is connected to it by an "umbilical cord," through which a crew member carries out full control checks during the climb. When these are completed, the link is disconnected and all subsequent control is carried out by the squadron commander from his command post on the ground. As the B-26 comes up to the launching point, it is joined by an F-86 "chase plane" which observes and reports the drone's manœuvres. If the drone for some reason gets badly out of control, the chase plane's duty is to shoot it down. It is unlikely to have to do so, however, because an automatic device within the Firebee ensures that, should ground control be lost, a recovery parachute will open and lower the drone to earth.

The ground controller directs a planned series of manœuvres and finally, when the Firebee runs out of fuel, he controls its recovery by parachute. Because of its high speed and altitude it is not possible to keep the Firebee in sight from the ground position and its progress is therefore plotted on a board.

As soon as these preliminary tests are completed, in the not-too-distant future, the 3225th Drone Squadron is likely to become the first operational Firebee target squadron in service. It will be followed by other squadrons whose operations will be planned on the basis of the techniques worked out by the 3225th squadron.

THE BRAZILIAN METEORS

IT was in late 1952 that the Brazilian Government ordered 70 Meteors for the Brazilian Air Force. Negotiations were opened after a member of the Brazilian Air Minister's staff had seen the Meteor demonstrated at that year's S.B.A.C. Display. When the contract was signed the Meteors became the first aircraft bought by Brazil from outside the Americas for over 20 years.

The aircraft were shipped in crates. There were seven crates for two aircraft: one for each centre section; one for each front fuselage; two each holding a rear fuselage and tailplane; and one for two pairs of main planes.

A team of Gloster technicians and two Rolls-Royce representatives went to Brazil to supervise assembly and carry out flight tests. Crates were taken to a Brazilian factory hangar at Galeao airport, and when sufficient had collected, after some initial delays, an assembly line was set up producing ten aircraft per month.

The first Meteor flight was the subject of a great deal of publicity, and the Brazilian Air Minister himself flew as passenger in the aircraft (a Meteor 7) with W/C. McDowall, of Glosters. As soon as airfield extensions at Santa Cruz were sufficiently advanced, a training flight was set up there and, on July 26th last year, eight Meteors were demonstrated for the first time by newly trained Brazilian pilots. In the course of a spectacular beat-up of the Copacabana Beach, one aircraft suffered skin wrinkling after a high-g pull-out.

On September 7th, Brazilian Independence Day, 20 Meteors were ready and 16 of them were flown over the military parade held for the occasion. Finally, on October 23rd, President Vargas officially handed over 24 aircraft to two squadrons of the Brazilian Air Force. During the ceremony he himself was taken up in a Meteor 7, his flight receiving widespread publicity.

More than half the aircraft originally ordered have now been assembled and delivered and extensively demonstrated.

THE CAULDRON AND THE BANNER

EVEN if only as a reminder that nature can produce clouds just as strange and fascinating as those of present-day nuclear physicists—but with somewhat less unpleasant results—the two aerial pictures on this page are worthy of note. The upper one, taken from a U.S.A.F. RB-29, shows the circular edge of the "eye" of a tropical typhoon encountered near the Philippine Islands. While turbulence is extremely violent inside the towering nimbo-stratus, the centre core (often almost cloud-free) can consist of surprisingly stable air. The lenticular billow cloud seen below was photographed near Middlemarch, South Island, New Zealand, and owes its unusual and striking appearance to a combination of a typical lee wave cloud and pre-frontal conditions. In spite of the remarkable impression of motion, the cloud itself is stationary, the lenticular structure and distinct striations indicating that the wind is actually blowing at high velocity "through" the cloud formation.

AIRLINE ENGINEERING

B.E.A. Chief Project and Development Engineer's R.Ae.S. Lecture

BEFORE the Chester branch of the Royal Aeronautical Society on April 8th, a "main" lecture, *Practical Experience of Airline Engineering*, was presented by Mr. R. C. Morgan, O.B.E., F.R.Ae.S., chief project and development engineer of British European Airways. The president of the Society, Sir William Farren, who took the chair for the meeting, was introduced by Mr. K. G. Hancock, chairman of the Chester branch. We reproduce in these pages an abridged version of Mr. Morgan's paper.

During the few years since the formation of B.E.A. [the lecturer said] a pattern of airline engineering has been evolved which, while broadly similar to that adopted in most of the world's larger airlines, is in some ways perhaps unique. It is the purpose of this paper to discuss a few of the lessons learnt during the formation and growth of the technical side of the airline. Of successes there have been many, and in the face of various factors which have influenced the task, the degree of success achieved is perhaps surprising.

With the need in air transport for emphasis on "development in service" has grown up a new engineering profession—that of the airline engineer. The Wright brothers were the engineers; they built, experimented, flew, maintained, modified and built again on the basis of their experience. Since that time, the manufacturer and the user have become separated, with the expansion of the aircraft manufacturing industry. In the earlier years, the successful construction and sale of an aircraft was the completion of the job. Afterwards, all that was required was a pilot to fly and a mechanic to maintain it. It was simple to fly (if sometimes hazardous!) and straightforward to maintain.

Nowadays, the completion and sale of the transport aircraft is only part of the job. A new machine has then to be tried out in practice and modified while in service, as a result of experience, until it is capable of repetitive use day in and day out for periods exceeding ten years.

As the equipment became more complicated and the demands upon it and those handling it—mechanics, pilots, traffic staff—became more stringent, the need for professional engineers on the airline became more evident. Although beginning in many places, such as with the specification for the Empire flying-boats by Imperial Airways, the new concept of the professional airline engineer probably took its foremost hold with the work of American Airlines on the DC-3.

Experience of the performance and usefulness of the civil transport equipment in service has now become not (as in so many military cases) the performance of one task with the utmost efficiency at one moment in time, but *the continuous execution of a complex task all day and every day to an acceptable standard of efficiency, with no possibility of a pause.*

On top, therefore, of daily routine maintenance of the equipment to a continuously acceptable standard, the engineer in the airline has to cover a very wide field, including (1) collecting and interpreting the experience of all parts of the airline (maintenance, flight operations, traffic, schedules planning, and so on) on the equipment in use; (2) solving all the technical problems arising with the equipment; (3) assessing proposals to alter the equipment; (4) initiating action arising from the above, both as regards development of the equipment itself and techniques for its maintenance and operation; and (5) interpreting the whole of this work into requirements for new equipment.

The only justification for the use of professional engineers on this sort of work within an operating organization is that it should pay. It does pay, handsomely, since the engineer's entire energies are directed towards the two basic elements of success—safety and economy.

As regards safety, many of the problems which arise on the modern transport aircraft are so complex and specialized that even with the greatest help from the manufacturing industry, professional engineers, including a number of specialists, are essential within the airline.

As regards economy, it is often a very tricky matter to decide what should be altered to improve overall operating economics, with relation to both reduction in cost and increase in revenue. It has proved essential to have engineers who can weigh the balance between the frequently conflicting requirements of maintenance, operations and even the manufacturer! In this field of his work the airline engineer can continuously produce economies amounting to many times the cost of his salary.

Notwithstanding substantial variations between the world airlines in the titles of their engineering personnel, and corresponding differences in responsibilities, the same general pattern of organization has emerged on both sides of the Atlantic for dealing with the airline's complex technical problems. The "airline engineer" is to be found in each of them, acting as the central source of technical knowledge for the airline, and the reservoir of the operator's technical experience.

The broad pattern follows the lines of division of responsibility into two main parts: maintenance and "project and development"—or in American nomenclature maintenance and "engineering." In B.E.A., the engineering activity has the following aims: (1) to keep the aircraft fleet flying for the maximum practicable proportion of every day; (2) to improve the aircraft in the fleet so that they can do their job more effectively and more economically; (3) to develop new types of aircraft for the airline. (This involves both original work and close collaboration with manufacturers and other airlines.) The first of these activities is the responsibility of the maintenance and inspection departments. The project and development department, while wholly responsible for items 2 and 3, shares responsibility for the first, helping with solutions to technical problems which arise, and the development of equipment and techniques. The purchasing department provides a specialized service for the contracting out and buying of spares, materials, overhauls, modification parts and so on. These are the four main departments responsible to the chief engineer.

New Equipment. The only way to get new equipment to the stage when it can be operated continuously with safety and economy is by development in service. By the time such equipment, whether complete aircraft or component parts, is delivered to the first operator, the maker and the legislative authorities should have provided for its safety in initial operation. It is only by the most energetic development in service, however, that safety can be maintained and economy of operation assured.

This development in service means two things: (a) development of the equipment on the basis of actual use in service—maintaining or improving the safety of the equipment by modification or alteration or techniques, while continually reducing its operating cost, and (b) alteration of the equipment to meet changing needs.

Engineering development in B.E.A. therefore covers (a) the solution of the daily and long-term technical problems arising everywhere within the airline, and the provision of the necessary technical information and advice to keep the aircraft flying; (b) development of the existing equipment in service and of techniques for its use to give maximum efficiency; and (c) the introduction of new equipment to improve on the old.

When B.E.A. was first formed, we were faced with the initial operation of an assortment of various pre-war aircraft types and the immediate introduction of the Viking. In addition there was the task of preparing the way for the introduction of the Viscount. It was decided at the outset that the most practical result would be achieved if project work on new equipment and the current development of existing equipment were combined under one responsibility. Wherever possible, therefore, each development engineer combined responsibility for a new equipment with current responsibility for equipment of a similar kind in service. In this way, competent liaison between user and manufacturer could be established, and the most realistic requirements for new equipment formulated.

Starting with a handful of men in 1946, the project and development branch has grown to 127 members and its responsibilities broadened to include helicopters. The development of this manpower for the different types is shown in Fig. 1.

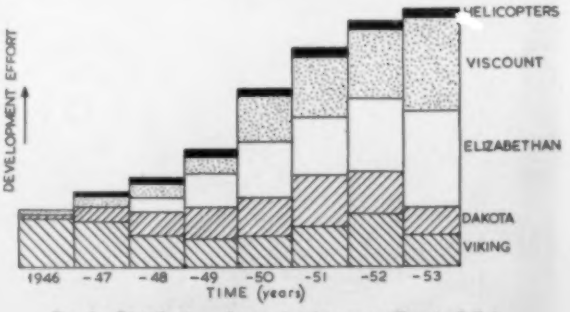
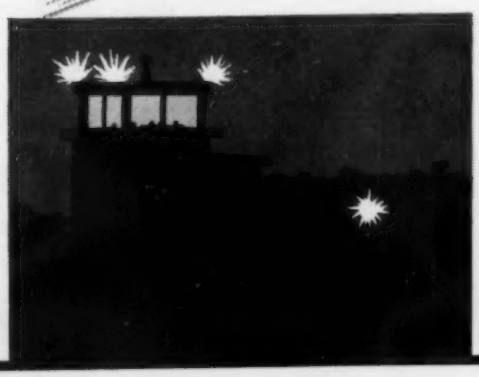


Fig. 1. Distribution of type-development effort in B.E.A.

G.E.C.

DOUBLE OBSTRUCTION LIGHT



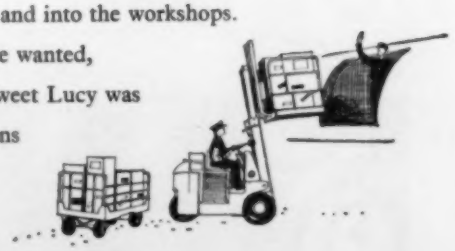
The New G.E.C. double obstruction light has been specially designed for use on, or in the vicinity of airfields to give warning of dangerous obstructions to aircraft.

G.E.C. lighting engineers are at the disposal of Airport Authorities to give advice and prepare schemes for the correct use of this obstruction light in accordance with I.C.A.O. recommendations.

This light employs 75 watt Osram lamps.

SWEET LUCY WILL WIN US THE 1960 AIR RACE

In the field of civil aviation,
Britain is today well ahead. Thank the
brilliant men who have designed, made and flown
our great new aircraft for that. But thank as well Sweet Lucy,
an unspectacular flier, for making sure that things *stay*
that way. How? Simply by flying to the start of an important race by BEA
air freighter. Her fare (pity she doesn't know it) helps to take
the world-beating airliners of the future off the drawing boards and into the workshops.
And helps the British airlines to send their experts, when they're wanted,
to these workshops with practical help and advice. Of course, Sweet Lucy was
only one among many. Last year alone BEA flew over 14,900 tons
of freight and 1½ million passengers. And the more
there are this year the better it will be for British flying.



freight
fly British keep British aircraft ahead fly **BEA**

BRITISH EUROPEAN AIRWAYS

AIRLINE ENGINEERING . . .

As in most airlines, B.E.A.'s maintenance function covers both routine maintenance of the aircraft on the routes, and overhaul of equipment as well as aircraft. The major difference between B.E.A. and other airlines, however, lies in the use of the incentive bonus system. While experience has shown that such a system can reasonably be applied to the process of aircraft maintenance and overhaul and be well worth while, a good deal is still being learnt on the detail application of the system to the peculiar requirements of aircraft maintenance.

The incentive bonus scheme was first introduced after the Vikings had been put into service, and with it came a maintenance system of centralized planning and rate-fixing. The emphasis was on planning of work in detail before the aircraft came in for maintenance or overhaul, each man being given detailed instructions of the job to be done and how to do it. This particular approach was developed while the Viking was being developed and was settling down in service. Thus, as the particular idiosyncrasies of the Viking became well known, and the sort of troubles encountered on all new aircraft were dealt with, so the maintenance on the aircraft became more and more a matter of standardized routine.

The difficulty with a system which depends on knowing too precisely in advance the work to be done on each check before the aircraft comes in, is that it can lead to lack of flexibility on the job, difficulty in making last-minute adjustments, and difficulty in incorporating modifications on which the ultimate success of the operation depends.

Two basic factors which determine the cost of maintenance in the airline are the amount of work to be done on the equipment and the cost of the replacements (spare parts and materials) required. The actual cost at any time arising from these two factors is a reflection of a number of things, and in particular (1) the suitability of the equipment for operational wear and serviceability; (2) suitability for ease of maintenance; (3) the total flying hours accumulated and the amount of experience obtained as a result; (4) the administrative skill in planning the maintenance work on the checks; (5) technical skill in deciding just how much work need be done.

The great bugbear in the airline is the "special check" which appears on the maintenance schedule because some trouble has been experienced. It is so easy for the airline staff to call for a special check, or a check of all aircraft within a certain time. The Air Registration Board and the manufacturer also ask for such checks. Each time, the maintenance cost goes up and the check time cycle is affected.

When the designer has done his best in the first place, and after the equipment has had initial testing and improving and has been bought by the airline, the only way in which the work set by the maintenance schedules can be reduced is to make the utmost use of experience in operation in extending the periods between inspection, adjustments, tests and cleaning and greasing operations. This means continual critical review of the work done, rapid development action on troubles arising, and rapid incorporation of modifications to develop the efficiency of the equipment. Adequate effort put into this work pays handsome dividends.

"Trouble Shooting." Any system, however good, will fall down if the daily and hourly diagnosis of troubles is poor. The cost of maintenance on new equipment, instead of being steadily reduced, will stay static or even rise if rapid and intelligent diagnosis is not done. Troubles rise at all stages of the game; on the tarmac just before flight, while the aircraft is on a routine check, on overhaul, in the workshops. The accurate and expeditious diagnosis of faults and their precise location demands trained competent personnel, adequate test equipment, and flying equipment so designed that fault-finding is practicable. The airline must provide the first two of these and the manufacturer the third.

Diagnosis—or more colloquially, fault-finding or "trouble shooting"—is directed at finding the location of the fault in the quickest possible time, so that it can be rectified in the most convenient manner, e.g., replacement of faulty components, adjustment or repair. Diagnosis is not intended to discover the root cause of faults, although it will sometimes expose them; this part of the work demands a totally different approach and may easily take weeks in complicated cases.

The investigation of the root causes of troubles, defects and difficulty covers not only those experienced by the maintenance department, but also by others handling and using the equipment, e.g., traffic, catering, and flying staff. It provides the material and experience for the alteration of equipment and techniques in service and also the vital experience on which requirements for new equipment can be based.

Troubles sometimes arise, particularly with new equipment, in which routine rectification is not enough by itself without immediate investigation into the root cause; in these cases, the development staff is called in at once. This has two effects of economic benefit to the airline: in the first place it helps to "keep the aircraft flying"; and secondly the development staff get to know first-hand the sort of things that are really hurting the airline, costing it money and causing dislocation.

Thus, from the initial occurrence of the trouble, there are two chains of action. The first is the diagnosis of the fault and its immediate rectification, resulting in the equipment being put back on the service in its original state, while the action taken is recorded so that subsequent investigation can trace back on what was done: the second chain is the establishment of the cause of the fault and taking action to eliminate its recurrence.

The necessary development of new aircraft and equipment after they are designed is in three parts; maker's tests and trials, proving and familiarization trials, and development in service. Much has been written on the subject of the design and supply of equipment, so that it does not require development in service, e.g., components already proven to run long lives. The facts of life are, however, that in the air transport business, the quantities of new equipment likely to be sold are comparatively small, and all pre-service trials and testing will put up the initial cost of each piece of equipment. There is therefore an economic limit to the amount of testing and proving which can be done by the maker. This limit must, however, be sought and in our experience there are cases where insufficient pre-service testing has been done; on the other hand, experience shows it to be very unlikely that the most extensive bench-testing will provide an automatic long life in service with complete freedom from teething troubles.

The amount of proving of a new aircraft before service is also a matter of economics—it will cost a lot, for example, to do extended proving flying of whole aircraft. Yet there is no other way of seeing how the equipment will perform. On the Viscount and Elizabethan 200 hours' proving flying was done on each, apart from makers' trials and operators' training. Experience shows that no new aircraft of any size or complexity should be put into service with less than this. It is extremely important that this proving flying should simulate precisely the conditions of operation in all respects, and for this reason there is no doubt that the first operator should do it, however it is financed.

Development in Service. This is a much more difficult and costly task, not even capable of solution by "just getting the money from somewhere." A separate development aircraft can only be used for tests and trials involving relatively few hours of flying. Development in service carries big financial rewards, but can only be done on the basis of many hours' use; the real proving of a new aircraft, therefore, demands many hundreds of hours in actual service. This is essential on all new equipment and yet is very difficult indeed to do. Any disturbance of standardized maintenance or flying schedule routines will be costly in manpower or in the time the aircraft is off service, yet a modification or trial of a new piece of equipment or change in technique may lead to very substantial reduction of maintenance costs or time off in service. More important, the reduction is not just an isolated case at one moment in time, but probably capable of recurring for the rest of the life of the equipment. We thus have the paradox that the maintenance and flight operating routines must be continually disturbed in order to discover or try out the very necessary means of improving them.

Modifications are the core of development in service. It is a fact perhaps not appreciated by many that all proposed modifications can be judged on financial grounds. In B.E.A., no proposal to alter either the aircraft or any part of the flying equipment can get beyond the examination stage until the financial result likely to accrue has been assessed, and authorization given. The development engineers have been trained from the outset to think commercially and to produce a balance sheet for what they are doing, showing the cost, the economic penalties and the advantages.

In our experience, the use of development engineers trained to think in terms of economics, and the insistence that all proposals to alter equipment should pass through this system have resulted in enormous savings through the efficient control of modifications. No separate system of weight control is necessary. Any such system of modification control, however, is ineffective if the modifications receiving approval are not incorporated quickly.

The traffic pattern of B.E.A. is highly seasonal. Although the summer peaks may be reduced in degrees by various means they are likely to persist. The heavy work period for engineering staff is therefore in the summer, and the problem we have not yet solved is how to deal with this situation most economically. The prospect of a solution has been confused by the introduction of the two new types so close together, and the extensive modification programme being performed on the Elizabethan.

We have for some years employed the system of progressive maintenance, on which the aircraft never comes in for an annual overhaul, this work being broken down into parts done at one or other of four successive major checks. This enables a much more constant work load to be planned for hangars and work-

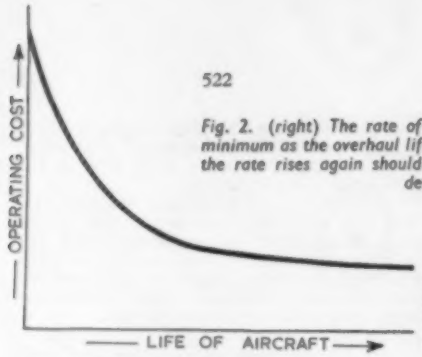


Fig. 2. (right) The rate of defect occurrence initially decreases to a minimum as the overhaul life of the component is increased. Only when the rate rises again should the life be restricted, until extended by development action.

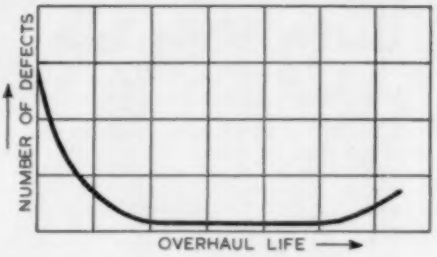


Fig. 3. (left). Effect of learning period on operating cost. Introduction of a brand-new aircraft is inevitably accompanied by a low utilization and high cost.

AIRLINE ENGINEERING . . .

shops. It would seem, however, that in view of the seasonal fluctuation, the overall engineering costs might be reduced if some of this summer work—and possibly the incorporation of modifications—were held over.

The answer to this problem is probably one of compromise. The continuous cycle of maintenance and operation considered against these traffic peaks emphasizes the often-conflicting requirements of airline routine *versus* economic development.

It is not practicable nor economically justifiable to attempt to cure by modification and to prevent the recurrence of all defects. It is only possible to tackle some—the problem is which?

Where should the priority lie if, as so often is the case, it is not possible to do everything simultaneously? Should it be for a small modification to correct a defect which has only occurred a very few times out on the routes, but has delayed an aircraft each time? Should it be a large modification required by the maintenance base because of excessive manpower use on overhauls in view of some continual failure, but which has not delayed an aircraft? Or should a modification insisted on by the operating side, but difficult to measure economically, have preference?

A detailed study of the engineering service delays over a fixed period on one aircraft type shows a very great scatter of different causes. [As appendices to the lecture, Mr. Morgan included a complete list of the causes of engineering delays on Elizabethan aircraft for periods of one and six months.] The best method of allocating priorities again seems to be a judicious compromise, making full use of defect summaries and statistics in combination with the actual experience of what is hurting most on the job.

As mentioned, the rapid development of overhaul lives in service when new equipment is being introduced is important. To assist in this work, records are maintained of defects on time-lifed components in the form of charts. It is possible to recognize a standard pattern of defect occurrence on which the overhaul life had little direct bearing. The basis of the theory is that defects did occur early in the life of groups of time-lifed components, but that the rate decreased to a minimum value with increase of life; only when the curve starts to rise again should the life be restricted until extended by development action (see Fig. 2).

With a new aircraft being operated for the first time, not only the aircraft but everything connected with it has to be developed, with the consequent increase in costs. Overhaul lives will be low, inspection periods frequent, and maintenance costs high. Operating and maintenance techniques have to be decided on, developed and taught; unpredictable incidents will be high and utilization low at first.

It follows that economical operation will not be achieved at the beginning of the introduction of a brand-new aircraft (see Fig. 3). To the first operator the economic advantages in other directions of a new type would have to be shown to outweigh the cost of introduction in the early years. A figure of £1,000,000 has been quoted as the approximate cost to B.E.A. of being the first operator of the Viscount.

Generally speaking, new equipment seems to perform well when it is first put into service, and then frequently falls into a trough of difficulty—a trough of varying and unpredictable depth. This impression of successful operation at the start can be most misleading, and the cause of much subsequent acrimony. Looking back, when new equipment has appeared to behave in this way, the reason is usually found to be a combination of two things; the actual newness of the whole equipment itself, and the undue and costly care which is inevitably lavished upon it during its initial operation. Throughout this stage, therefore, it is necessary to be extremely cautious on the subject of how the equipment is turning out.

Close liaison over a very long period between operator and manufacturer is clearly the best way of getting the operator's experience into the hands of the manufacturer and the designer. The use of service representatives by the manufacturer goes only a small way towards meeting the problem. By this means, the maker undoubtedly gets to know the faults which occur, but he does not and cannot get to know their significance to the operator, except in the more obvious cases.

In my view, this gap could be further bridged by better training of design staffs in the practical requirements of civil operation. Two ways are suggested. First, that anyone undergoing engineering training for any aspect of civil aircraft design, manufacture or operation should spend a period working for the operator with the development staff. Secondly, that selected people should be sent from the drawing office and technical departments of the civil aircraft manufacturer to the operator for a similar purpose.

No remarks on experience in airline engineering would be complete without reference to design for ease of maintenance and operation. Great strides in this direction have been made on both sides of the Atlantic, but still more can be done; when designing new equipment, it all has to be done over again. This is a vital part of the total engineering of a new aircraft project, and the biggest difficulty seems to be that of getting practical operating knowledge into the manufacturer's design office.

There appear to be nine major points to which detail designers should pay special attention. These are:

(1) Simplicity.
(2) Reliability.
(3) Accessibility—can you get at the component?
(4) Replaceability—can *one man* replace it?
(5) Interchangeability—will it come off one aircraft and go straight on to another?
(6) Repeatability—will it perform to standard when replaced or readjusted without fiddling?
(7) Robustness—will it last?
(8) External servicing—can it be done in the cold and wet without special tools?
(9) The control cabin—can it be cleaned easily?

One of the problems arising on new equipment is that of learning quickly the best techniques for maintenance and finding out as easily as possible whether the design is satisfactory from this point of view. To establish the basic procedures for maintenance of each part of the aircraft, and to check on the suitability of detail design and component accessibility, we instituted a series of checks to be made on prototype aircraft and, where this was not representative, on the production line at various assembly stages. We try to make a practice of doing these servicing development trials in the earliest possible stages of any new equipment on order—from new-type aircraft down to individual components.

Conclusions.—In my experience the nature of the airline engineering task, and the dependence of the airline and the manufacturer on the skill of the airline engineer have been insufficiently appreciated. As I have shown, the effect he can have on the economics and success of the equipment is considerable. His work is only possible if those with whom he has to deal and on whom he depends to get the work done, understand the nature of the task and the factors which affect it.

The statement is often made that air transport is just like any other business, and in the sense that it should be self-supporting this is true. But in a highly competitive market with a flavour of national survival, the backbone of the job is suitable, up-to-date equipment operated safely and economically. This can only be achieved by active development in service. I have shown the technical nature of the task and the very serious way in which external influences can affect the economics.

The total cost of introducing new aircraft includes the cost of development in service. The work of introduction and this development in service is as much part of building and selling a new aircraft as the work done by the maker. It is expensive. We have shown that we can do the job technically, but need the finance to cover it. Many can produce project designs for new civil aircraft, but few can undertake with success the total engineering needed to produce a first-class job. Continuity of experience and a strong manufacturer/operator liaison is essential.

We have a very small number of engineers in this country with operating experience who are in a position to transmit this to the manufacturer. We must therefore concentrate the maximum effort on the smallest possible number of new types and not spread the limited skilled effort available over too many. Only by so doing can we produce aircraft which will succeed in our own airlines and in the export markets.

MR. MORGAN'S PAPER DISCUSSED

Opening the discussion on Mr. Morgan's paper, MR. S. D. DAVIES, chief designer, A. V. Roe and Co., Ltd., said that it had been based on practical experience and undoubtedly reflected the harsh realities of life. The cost problem was at the heart of whether or not civil aviation was ever going to be commercial aviation, and in this connection the introduction of new aircraft struck him as being the prime factor which affected the manufacturer.

No matter how much the manufacturer tried to clear his snags he would not clear the equipment snags without hundreds of hours of running. If we could fairly say that a large proportion of the snags were of a secondary nature, would more prolonged and very severe ground rig testing go any way in that direction to show them up earlier? A possible way in which this might be done was to build a non-flying aeroplane continuously subjected to vibration tests.

The speaker thought it was possible to visualize a successful civil aircraft based on the structural design of a military aircraft. Many desirable aspects of civil aircraft were just as desirable in the military field. This possible solution should not be too lightly dismissed because it did show a means of reducing the development costs and possible tooling costs.

MR. B. S. SHENSTONE, chief engineer, B.E.A., said that the difficulty was to decide which defect to get after, there being so many. One could do what Mr. Morgan suggested and make an analysis and find out that a defect occurred often enough and cost sufficient delays, and they were the defects to go after. But everybody in the world was not so analytical as Mr. Morgan, and some people said "Go to the man on the job; he will tell you." That had been tried, and the man on the job had listed the defects, but one found that all he had listed were the defects he had met in the last two days (and they might have been good days or bad days) and were not the defects which mattered at all. The other alternative was to listen to what one was told. "If so-and-so is not done we won't fly it any more"; that was a method which was extremely difficult to resist. It depended upon who said it. Really the best way to do it was the way Mr. Morgan suggested plus just a little give-away to certain people who wanted something done regardless.

MR. P. B. LAIGHT, chief designer, Blackburn and General Aircraft, Ltd., said he was very grateful to Mr. Morgan for such an excellent exposition of the real basic know-how accumulated in his work. The basic trouble with an aircraft was that the manufacturer probably could not test it for more than 500 to 1,000 hours. By "could not," he meant did not usually do so because calendar time went by very quickly and flying hours did not build up very rapidly.

Mr. Laight said he would be interested to know how the lecturer arrived at lives for his various components. It was too often the case that, after a lot of technical discussion or bench work, the manufacturer of that piece went to the aircraft man and said "Here it is; you can have it for 20 hours and then back to our factory and we will strip it down." The aircraft man should get progressively tougher with people who put things in his aeroplane. He ought to insist that they did not go in the aircraft unless the men who made them were willing to trust them for quite a long time.

MR. B. H. SLATTER (Armstrong Siddeley) remarked that in the military field of aviation if an aircraft or its engine ever reached the stage where it was considered fully developed it was also considered to be obsolete. Referring to the introduction of modifications, he said that it looked delightfully simple but quite frequently a modification involved safety. How could one assess the worth of safety in commercial terms?

Mr. Slatter felt that the gap between testing by the manufacturer and airline service might be improved if one of the aircraft of a new fleet was set aside for experimental work—and used for freighting, perhaps. All modifications and proposed new equipment could be tried out on that aircraft.

"Practical and Sincere"

The next speaker was MR. N. E. ROWE, technical director, Blackburn and General Aircraft. As chairman of the Branches Committee, he congratulated the branch on the first-rate organization and excellent attendance at the lecture. He said that the paper epitomized in a most direct and sincere way the practical experience of a practical man. With Mr. Davies (and Sir William Farren) he took up the question of discrimination between military and civil practice. For the national benefit it was important that these points should be attended to in military aircraft as in civil aircraft.

When he had been with B.E.A., Mr. Rowe said, he was very much impressed by what he called the random failure because it did seem to him that it was the random failure that was leading to gross "diseconomy." It meant that one had to have more aircraft than one would otherwise need and it also meant that one probably ordered the wrong spares because one thought things were going to have a certain life and they did not.

He referred to an experiment which was being tried in conjunction with the Ministry of Supply whereby bits and pieces had been taken from an Elizabethan and into an elaborate set-up were fed what were regarded as the vital factors—vibration, moisture, dust and variation in temperature—which were thought responsible for failures in service of equipment. That work had been going on for some time and had reached about 2,000 hours. He did not think the method would necessarily be guaranteed to give results, but a lot ought to be learnt from it. Development in flight was a very expensive business—expensive for the manufacturer and for the operator, and simulation should be studied.

MR. C. B. V. NEILSON, technical director and chief designer, Electro-Hydraulics, Ltd., said that, having been responsible for the design of some equipment on an aircraft going into regular airline service, he could confirm what previous speakers had said—that they did not at the time of design know anything like enough about it. After it had been in service for a short time all sorts of troubles had developed, and they had had to get down to it in the design office and laboratories and find solutions. In introducing those solutions they had put out a working party to take the aircraft as soon as it came out of service and overhaul all the hydraulic equipment and had put it straight back into service without delaying the regular schedule.

MR. H. B. CUNDALL (Hunting-Clan) was the last speaker. He remarked that components seemed to last much better if they were left alone. Surely we should try to utilize their lives to the full? He believed that B.E.A. used a system where they took a component off at a check regardless of whether it had lasted its life or not. Had we done as much as we could to get these lives increased, and was the present system of holding these lives down the best that could be achieved?

The Lecturer Replies

Replying to the discussion, MR. MORGAN said that Mr. Davies was the most difficult to answer because he (the lecturer) was not sure whether he agreed entirely with him or not.

The thread running through the speakers' remarks was of ways of reducing the high cost of introduction of an aircraft. He still came back to the point of designing it in the first place for the purpose.

The importance of manuals in cutting down these high introduction costs could not be over-stressed. The information in the manuals should be a reflection of what the designer knew of the operators' need when he designed the job.

On the subject of proving by the manufacturer and rig-testing, his view was one of compromise. He could see from the tests Mr. Rowe had mentioned that there was great advantage to be gained from ground testing of equipment in advance. But it took a long time to build up hours on a ground rig. He did not agree with Mr. Davies' view that a full-scale ground aeroplane would be the thing. He had mentioned in his paper the proving flight aspect and there he did believe that a very great deal could be done, although the hours were short. Providing the flying hours simulated airline conditions accurately, a tremendous amount could be learned from them.

Mr. Morgan said that he considered the present system satisfactory with regard to overhaul lives of components. He had given some detail in the paper and referred to previous papers by Hardingham and Tye showing how the approach to component life in this country had changed since the war. On engines, for example, when they first took the aircraft they had been able to set out a programme of life development which startled everyone concerned. With the tremendous assistance from the manufacturers that programme had been adhered to. They had reached the target overhaul lives for the two engines concerned.

The point of throwing away lives on checks had been argued about a great deal. The difficulty was to keep the work down. On the maintenance cycle one had to spread the major checks as far apart as possible. It was tricky to get a component to go in steps of 1,000 hours. B.E.A. were trying to tighten up on the amount of life thrown away on components, but they were certain that where components ran oddly and out of phase, depending upon the overhaul cost of the particular components, it was worth throwing away overhaul lives to keep the aircraft flying most of its time and to adhere to the maintenance cycle.

Concerning civil and military aircraft, it remained a fact that military aircraft had a job to do at one moment in time. Whilst he agreed with the various speakers that many of the things mentioned in the paper could, and should, be applied to military aircraft, there was still one difference—even whilst military aircraft had to remain serviceable for peacetime use, the number of hours they flew was very small. The difference was between short-life and long-life operation—and it did make a difference in the application of the sort of things mentioned in the paper.

Concluding the meeting, SIR WILLIAM FARREN asked if it was realized what a lot we were asking of the aircraft. Was any branch of transport really economical? We should be very uncomfortable if every method of transport were eliminated which could not make a profit. Was the aircraft worth it? He thought it was.

DEVELOPMENTS IN INSTRUMENTATION

—at the Physical Society's Exhibition

THE demand for space at the 38th annual exhibition of the Physical Society, held at Imperial College, London, from April 8th to 13th, proved so great that the number of exhibitors had to be limited to 103. This explained the extra section in the Society's handbook devoted to non-exhibitors and describing those items "which would have been exhibited if space had been available."

It transpired that among these particular "non-exhibits" were the products of the electronic divisions of Boulton Paul Aircraft, Ltd., and Saunders-Roe, Ltd., and the precision engineering division of Short Brothers and Harland, Ltd. (who were to have shown one of the Short analogue computors now in production at Castlereagh). A special-purpose digital computor built by Saunders-Roe to an N.P.L. design was, however, among the exhibits on the National Physical Laboratory stand.

Among the items for which space was available, few were of specifically aeronautical interest, although many possessed specialized applications in the various subdivisions of aeronautical research, special instrumentation and testing—with, as might be expected, a pronounced electronic bias.

Much of direct application to aircraft, however, was seen on the Kelvin and Hughes stand. On public view for the first time was the firm's sensitive pitch-indicator, designed to show changes of angle from the horizontal attained by an aircraft during take-off or in flight. A pointer indication of from −2 deg to +15 deg is given, obtained by gearing from the outer gimbal of an electrically driven vertical-axis non-pendulous gyroscope of 1½in rotor diameter. As the gyro is not self-erecting, it is first lined up horizontally by caging the gyro frame, and rotating it until a mercury-operated switch extinguishes the warning light, showing that the gyro axis is vertical. The gyro frame can then be uncaged, the accuracy of the instrument being retained to within ½ deg for five minutes.

Shown by the same firm was a method of reducing the effect of friction in ball races, the principle being that, by rotating in opposite directions the inner races of a pair of ball bearings, the friction torque reaction on the outer races is almost completely cancelled out. The end-float, or "play," in conventional aircraft gyro gimbals can be a disadvantage when the system is subjected to a large amount of g, as the gimbal frames are moved out of position and cause the gyro to precess or wander. One means of overcoming this is to remove end-float by applying a force along the axis of the gimbal spindle, but this normally results in a loss of sensitivity. If, however, the spindles are free to revolve, the effect of the artificial load along the spindle axis is cancelled out and the sensitivity of the gimbal system is retained. Other advantages claimed for this method are that the sensitivity is virtually unaffected by quantities of dust in the ball races, and that the quality of the races does not need to be extremely high, an economic factor which must be considered when the gyro system is used in an expendable missile. Also shown was an extensive range of pressure capsules and capsule stacks.

Salford Electrical Instruments, Ltd., one of the G.E.C. group of companies, showed their Mk 5B radio altimeter, accurate to plus or minus 10ft at 200ft, and within 3 per cent of indicated height up to 5,000ft. On the R.A.E. section of the Ministry of Supply display was a cup anemometer incorporating a friction brake, giving an improved response to gusts of decreasing velocities, and also an air mass-flow meter covering a range of 6 to 90 lb/sq in absolute (static pressure), 0.2 to 9 lb/sq in differential (dynamic pressure), and 288 deg to 612 deg K (absolute temperature).

The Physical Society has announced that, because of the diminishing space available at Imperial College, arrangements are being made for the use of the Royal Horticultural Hall for next year's exhibition. It is hoped that the new location will enable the exhibition to retain its present character and continue to fulfil its service to science and the development of scientific instruments and apparatus.

WESTLAND SALES APPOINTMENT

THE appointment is announced of Captain H. A. Traill, C.B.E., R.N.(Ret.), to the Westland Aircraft sales organization, which is under the management of Mr. Harald Penrose.

Capt. Traill entered the Navy in 1917, and served in the aircraft carriers *Courageous* and *Glorious*, and with "catapult" aircraft in the 2nd Cruiser Squadron; he commanded No. 800 Fighter Squadron. In 1938 he was promoted to the rank of commander and appointed to the Naval Air Direction Staff at the Admiralty.

In April 1940 he joined H.M.S. *Ark Royal* as commander flying, later serving on the staff of the Flag Officer Air (Home) until November 1943, when he was appointed to command the escort carrier H.M.S. *Empress*. In April 1945 he became Naval Air Commander East Indies, and subsequently, after staff service at home, was in command of Naval air stations in Malta and of H.M.S. *Glory*.

Returning to the United Kingdom in 1950, he commanded H.M.S. *Perseus*, was engaged in development trials of the steam catapult, and subsequently went to the Admiralty as Director of Aircraft and Equipment and Naval Photography. He retired at the end of last year.

A FAMILIAR OUTLINE "INFLATED": THE SIKORSKY XHSS-1

Anchored for its "tie-down" tests is the XHSS-1 anti-submarine helicopter, which bears the Sikorsky works designation S-58 and has a 1,425 h.p. Wright Cyclone R-1820. The Editor of "Flight," who recently inspected this machine—and other new Sikorsky developments which we hope to describe in an early issue—writes that it is "bigger than it looks in pictures" and that it is, in fact, about 1½ times the size and weight of the S-55.

CIVIL AVIATION

ON THE DOT: Delivery of four Viscounts within the stipulated contract time has evoked a "congratulations and thanks" cable from Mr. Jerry Dempsey of Aer Lingus to the aviation division of Vickers-Armstrongs, Ltd. The telegram, to Mr. George Edwards, paid special tribute to workers at Vickers' Hurn factory. From Dublin, the setting for this picture, Aer Lingus Viscounts now fly regularly to London, Manchester and Amsterdam.

NON-STOP TO STOCKHOLM

NON-STOP service between London and Stockholm was inaugurated by B.E.A. on April 12th, when Viscount G-AMOI *Sir Hugh Willoughby*, piloted by Capt. H. C. Bailey, covered the 900-mile route in 3 hr 15 min precisely. This represented an average speed of 277 m.p.h. and an improvement of 20 min on the advertised time. Not since the late years of the war, when B.O.A.C.'s Mosquitoes ran a risky courier service between the United Kingdom and Stockholm, has there been a regular non-stop service on this route. The Mosquito, however, carried a single passenger in the bomb bay, swaddled in protective clothing, harness and oxygen mask, whereas the Viscount's 47 passengers enjoy all the comforts of home in their pressurized, heated, air-conditioned and liberally fenestrated cabin.

Three of the seven weekly return services between London and Stockholm now fly non-stop—outbound on Mondays, Wednesdays and Fridays, and on Tuesdays, Thursdays and Saturdays in the reverse direction. On other days the Viscount makes a 20-minute transit stop at Oslo. In addition, there is a daily round trip between London and Copenhagen.

A *Flight* representative who flew to Stockholm on the inaugural non-stop Viscount was met at Bromma by Tony Caro, B.E.A.'s active area manager, whose work has been made much more rewarding by the advent of the turboprop. The Viscount, he told us, has boosted the English airline's share of the total B.E.A./S.A.S. traffic between London and Stockholm from less than 30 to well over 50 per cent. Until the Viscount came along B.E.A. salesmen on both sides of the North Sea were fighting a losing battle against the growing public preference for four engines—coupled, in this case, with the extremely tough competition and excellent service offered by the Scandinavian airline.

North-westerly winds prevail on the Stockholm-London leg, and the return flight is scheduled to take 4 hr. But, despite an adverse wind component of 40 m.p.h., we flew back—aboard G-AMOA *George Vancouver* (Capt. C. G. Klimcke)—in 3hr 45 min.

Both outward and return flights were completely uneventful, the major point of interest being the extra speed at which Viscounts are now flown. A year ago, when the type entered service, the usual cruising speed was 295-300 m.p.h. This has recently gained some 20 m.p.h. as a result of an increase in the Darts' "max. continuous r.p.m." figure—from 13,300 to 13,600.

Although unique in so many other respects, the Viscount still suffers from the common complaint of airscrew-noise in the front part of the cabin. Some improvement has lately resulted from the installation of an additional sheet of Perspex inside the two foremost windows on each side of the cabin. A disadvantage, however, is that these four windows can no longer be used as emergency exits.

CANADIAN SUPER CONSTELLATIONS

NEWS of T.C.A.'s progress in preparing for the introduction, next month, of their Super Constellation fleet is contained in an on-the-spot report from Montreal by the Editor of *Flight*. At the time of writing, two of the L-1049Cs had been delivered, approximately on schedule. One is being used for intensive crew training and the other is being modified to the latest operational standard. About fifty modifications, practically all of a minor character, and recommended by the makers following experience gained by early operators of Super Constellations, are being made by T.C.A.; the work could not be done on Lockheed's production line without upsetting the flow of deliveries.

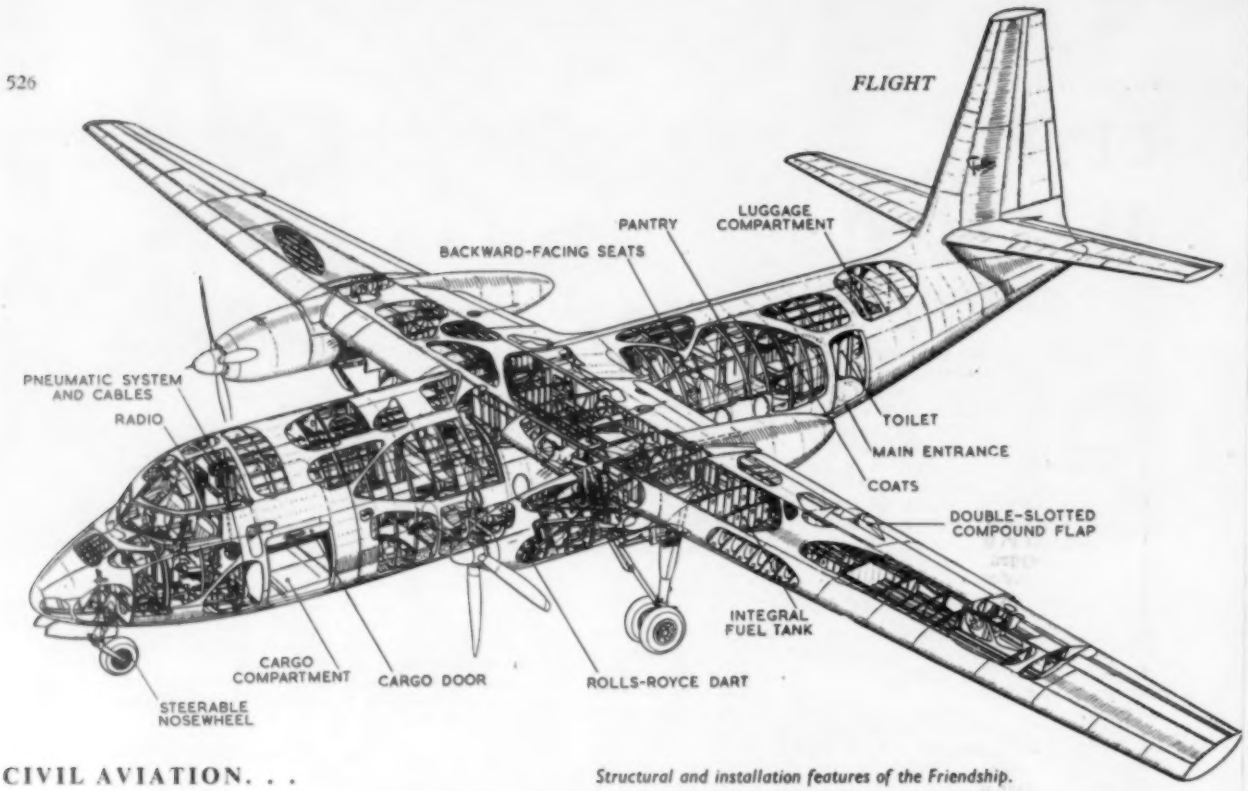
Incorporation of these modifications takes about 10 working days per aircraft. One of the tasks, which has been sub-contracted to Bristol's Canadian subsidiary, includes the drilling of four holes in the exhaust blower rotors of the Wright Turbo-Compound engines. This provides weak points for "controlled break-up"—rather than complete runaway and disintegration—in the event of over-speeding. Incidentally, these blowers are normally known as P.R.T.s (power recovery turbines).

T.C.A.'s Super Connies are being equipped as 61-seaters, with 54 tourist seats plus two small toilets in the main cabin, and seven fully reclining first-class seats and two larger toilets aft. The galley, which is situated opposite the main door, is the type made by Fokker to K.L.M. design and employs British G.E.C. ovens.

Ground and flight crews for the new Lockheed airliners are now undergoing very thorough and intensive conversion courses. The cost of ground-crew training alone is said to be £100,000, and the total training cost is given as nearly £215,000.

May 14th is expected to see the start of T.C.A.'s Super Connie services on the North Atlantic route. Early that day there will be a positioning flight from Montreal to Toronto, which will then continue east to London *via* Montreal and Gander. Later services are expected to extend to Paris.

IPOH, Malaya, is served four times daily by the Singapore-Penang services of Malayan Airways. The DC-3s operated by this private airline log some 1,700 hr annually on short routes without any night flying.



CIVIL AVIATION. . .

Structural and installation features of the Friendship.

FOKKER'S TWIN-DART FRIENDSHIP

DETAILED information has lately been released on the Dart-powered F.27 Friendship, two prototypes of which are being built by the Dutch Fokker works at Amsterdam. Illustrations published so far have shown a neat twin-engined airliner of conventional but modern design. The cost and performance data which Fokker are now making available to operators suggest that here is one of the most promising answers to the DC-3 replacement problem. Designed to carry up to 36 passengers over stage-lengths of 300-800 miles, the Friendship will be offered at a competitive basic price of £141,000.

The power unit selected is the Rolls-Royce Dart RDa5, which will deliver 1,540 s.h.p. plus 365 lb thrust for take-off. Two of these units (four of which, incidentally, will power the lengthened Viscount 800) will give the Dutch airliner an economical cruising speed of 266 m.p.h. at its normal operating height of 20,000ft.

Although the phrases will be familiar to British readers, Fokker's reasons for choosing the Dart are worth quoting, because they express an objective decision by a foreign manufacturer; there can be no suggestion here of using turbines for reasons of politics or prestige. Advantages of the turboprops are given as: "Lack of vibration due to the absence of reciprocating parts, the almost negligible daily servicing, favourable specific engine weight, small frontal area and cooling resistance. With regard to safety, a low frequency of engine failures may be expected, due to the smaller number of moving parts. Moreover, the stresses to which these parts are submitted are kept at a constant level. Kerosine fuel, less inflammable than petrol, reduces fire-hazard in accidents."

The fuselage has a diameter of 8ft 10.3in, which permits comfortable four-abreast seating, and a cabin height of 6ft 8in. It has a pressurized cabin 50ft long with normal capacity for 28 passengers in seven rows. By re-positioning the forward bulkhead, and reducing the capacity of the main freight compartment from 282 to 183 cu ft, four additional seats can be installed. Seating capacity can be further increased to 36 by moving the galley from the rear fuselage to the forward cargo compartment. Rearward-facing seats, attached to under-floor crash members and intended to protect passengers in the event of a forced landing, will be fitted as standard.

All three versions have an additional 100 cu ft of freight or luggage capacity at the after end of the pressurized section. A fourth arrangement, with more luxurious three-abreast seating for 24 passengers, is proposed for long flights, when payload would be limited by the fuel requirement.

The cabin is designed for a differential pressure of 16.4 lb/sq in, allowing a cabin altitude of 8,000ft to be maintained at 20,000ft. All fuel will be carried in two integral tanks outboard of the engines with a total capacity of 704 Imperial gallons. Underwing pressure-refuelling points will be installed only at the operator's request.

Advantages claimed for the Friendship's high wing arrangement include ease of access and freight loading; use of large diameter (12ft) airscrews, giving high thrust for take-off or overshoot; and an unimpeded view for passengers. The makers say that the wing loading of 43.3 lb/sq ft (at normal gross weight of 32,630 lb), combined with double-slotted, wide-span flaps especially designed for the aircraft, will give a low minimum speed —though no actual figure is quoted.

Wing de-icing will be effected through heat-exchangers placed in the leading edge inboard of the engines, engine exhaust being the form of heat utilized.

Other systems are as follows: pneumatic operation of undercarriage and wheel brakes (which will incorporate Maxaret automatic braking); pneumatic auxiliary power system; and two separate electrical systems for flaps, de-icing, radio, etc. Additional data for the Friendship are contained in the table below.

Operating costs for the Friendship have been worked out by the S.B.A.C. method as a function of stage distance. Assumptions include an annual utilization of 3,000 hr, an obsolescence period of eight years and an estimated engine-overhaul life of 1,200 hr by 1957. The direct operating cost per ton-mile for a 300-mile route—which is taken as the normal stage distance—works out at 15 pence at normal take-off weight. The corresponding passenger-mile cost is given as 1.43 pence.

FOKKER F.27 FRIENDSHIP

Two Rolls-Royce Dart RDa5 (1,540 s.h.p. + 365 lb. s.t. at take-off)

Dimensions:	
Span	95ft
Length	73ft
Height	26ft 6in
Wing area	754 sq ft
Weights and Loadings:	
Normal take-off weight	32,630 lb
Max. take-off weight	34,200 lb
Max. landing weight	32,630 lb
Max. zero fuel weight	30,860 lb
Manufacturer's weight empty (28-seat version)	20,610 lb
Max. payload (28-seat version)	9,535 lb
Performance	
Max. cruising speed at 20,000ft (13,800 r.p.m.)	280 m.p.h.
Economical cruising speed at 20,000ft (13,300 r.p.m.)	266 m.p.h.
Rate of climb (sea level, I.S.A.)	1,500ft/min
Service ceiling	35,000ft
Normal stage distance	300 miles
Max. stage distance	830 miles
Block speed on 300-mile stage	203 m.p.h.
Take-off run required (I.C.A.O.)	2,400ft
Take-off distance to 35ft (I.C.A.O.)	3,800ft
Landing distance (I.C.A.O.)	3,800ft

THE HERMES : B.O.A.C. STATEMENT

HERMES aircraft bought from B.O.A.C. by British independent operators will be used only for trooping and other work which the Corporation does not wish to undertake. This condition of sale was disclosed by Sir Miles Thomas in a message to B.O.A.C. staff on April 9th.

There are 19 Hermes for disposal. Sir Miles states that six are being sold to Britavia, three are on offer to Airwork and Skyways will acquire the remaining ten. He expresses his firm belief that these sales are by no means in conflict with the interests of the Corporation: "We have no need to fear that, with the growth of the independent companies, there will not be sufficient work for us to do. There can be more than enough for us all."

The message explains that, although the independents are paying a relatively low price for the Hermes, their offers are considered "reasonable and economically justifiable." The B.O.A.C. chairman says: "In selling the aircraft, we are trying to get the best price and terms obtainable in the interests of the Corporation and all who work in it. It has not been an easy task. Although the aircraft have been offered for sale throughout the world for more than six months, and although we have had a number of interested enquiries from overseas buyers, we have in fact received no firm offer from foreign buyers."

Referring to recent objections by B.O.A.C. staff to working on the aircraft (in an attempt to prevent the sale of the Hermes and to alter the Government's trooping policy), the message reminds employees that: "Whenever we in this Corporation are bringing new aircraft into service, we shall always have the problem of disposing of our older aircraft. We cannot go on adding aircraft to our fleet, and never shedding any. That being so, the problem of disposal arises anyway; and it is obviously in the best British interest that the aircraft should go to other operators in this country or to our associated companies within the Commonwealth rather than to foreign interests. . . Even if the Corporation successfully tendered for all long-term trooping contracts not already let, this would only provide work for a small proportion of our Hermes fleet. In any case, therefore, the Corporation has to sell the greater part of the fleet. Moreover, the Minister of Transport and Civil Aviation has recently re-affirmed in the House of Commons that the Corporations are not entitled to tender for long-term troop operations, as distinct from *ad hoc* troop movements. This policy was debated in Parliament and endorsed by majority vote; and we must loyally abide by it."

The logic of these remarks is inescapable, and it is difficult to see how B.O.A.C. maintenance men could find any further reasons for delaying the disposal of the Hermes. It is unfortunate, however, that there was an interval of over three weeks between the original strike threat and the distribution of the chairman's forthright statement of policy.

BREVITIES

CENTRAL AFRICAN AIRWAYS have recently increased the frequency of their Zambesi service from once to twice weekly. Operated by Vikings, services leave Salisbury on Saturdays and Tuesdays, operating *via* Lusaka and Ndola, and Blantyre and Dar-es-Salaam respectively. The return flights from London leave on Thursdays and Sundays. Since the Zambesi service was inaugurated in April 1953, 1,521 passengers have travelled on this low-fare service.

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It is reported from Istanbul that facilities and safety measures at Yesilkoy airport have attracted great interest from foreign air companies and that several agreements have been reached for more frequent services to Istanbul as from June 1st. The Turkish State Airline have announced that as soon as their new aircraft are delivered they will inaugurate services to foreign countries.

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S.A.S. were due to inaugurate a new service on April 12th from Stockholm to Israel *via* Dusseldorf, Vienna and Istanbul.

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The I.C.A.O. conference on the co-ordination of European air transport at Strasbourg was due to open on April 21st.

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Hungary is to extend its internal services during the summer. There will be five flights daily from Budapest to Debrecen (an increase of two) and the services from Budapest to Miskolc and Szeged are to be increased to four and three services daily respectively.

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A new first-class service was due to be inaugurated on April 17th between San Francisco and Manila by Pan American World Airways, who already operate two combination first-class and tourist services weekly on this route. The new flight is due to leave San Francisco each Saturday and from Manila each Tuesday.

* * *

From April 12th until May 15th Sabena are to operate a helicopter service over the famous Dutch tulip fields. Helicopters on the regular Brussels-Antwerp-Rotterdam service will fly from Rotterdam farther north, passing over the bulb area to Haarlem, Zandvoort and the Keukenhof National Flower Show near Lisse. A return trip from Rotterdam, *via* Keukenhof to either Haarlem or Zandvoort will cost about £4.

* * *

It is announced from Taipeh that the Republic of China and Thailand have decided to extend their agreement on air transportation until 31st March, 1955. The new agreement, which makes no changes in the original provisions, will be renewed from year to year unless one of the Governments expresses a wish to end it three months before the date of expiry.

* * *

President Eisenhower has given final approval to Airwork's application for a "foreign air carrier permit," to enable the company to operate its proposed all-freight service between London and New York. British Government approval was granted in February last year. The long delay in securing C.A.B. and Presidential approval is by no means unusual. Seaboard and Western Airlines have been making strenuous efforts to secure an Atlantic freight permit since July 1947.

Raymond A. Norden, president of Seaboard and Western Airlines, has announced that during 1953 his company received in revenue the record figure of £13,638,231 (£4,871,200), which is 13 per cent greater than the 1952 figure. The company flew 8,047,231 revenue miles during 1953 an increase of 16 per cent over the previous year's total. This summer Seaboard and Western are due to take delivery of four new Super Constellation freight aircraft. These will carry a payload of 18 tons at 300 m.p.h. in transatlantic operation, as compared with the company's DC-4s at present in use which fly an eight ton payload at 200 m.p.h.

FOR QANTAS : The first of eight Super Constellations for Australia's international airlines was officially handed over at San Francisco at the end of March. It was named "Southern Constellation" by Lady Spender, wife of the Australian Ambassador to Washington. Present at the ceremony were (left to right) Mr. G. J. Christopher, San Francisco Chamber of Commerce; Mr. C. O. Turner, general manager of Qantas; Lady Spender; Sir Percy Spender, the Ambassador; and Mr. C. B. Squier, vice-president, Lockheed Aircraft Corporation.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

NATO in the Mediterranean—

UNDER the direction of Admiral the Earl of Mountbatten, C-in-C. Allied Forces, Mediterranean, units of Southern European NATO forces have been engaged in Exercise Medflex A. A naval *force de raid*, composed of British and French units, was subjected to strong submarine, surface and air attacks by the Naval Striking Force, Southern Europe, themselves operating in Exercise Shield 1. Italian and French coastal air defence forces made several attacks on the *force de raid*, and French fighters and R.A.F. bombers were despatched to assist in the force's defence.

In the early hours of April 3rd, a night-encounter exercise was held, followed by a final air-defence exercise in conjunction with Italian and French defence systems. Aircraft from the carriers H.M.S. *Eagle* and H.M.S. *Warrior* also attacked land targets in North Africa, and ships at sea during the exercise.

—and in the Channel

SHIPS of the Royal Navy and the Norwegian and French Navies will take part in a minesweeping exercise in the Channel between April 30th and May 8th. The Allied C-in-C. Channel, Admiral Sir John Edelsten, G.C.B., G.C.V.O., C.B.E., will direct the operations. Practice mines will be laid by ships and submarines of the Royal Navy and by aircraft of R.A.F. Bomber Command in an area south of the Isle of Wight. In addition to minesweepers, units of the Royal Naval Minewatching Service will take part.

No. 8 Squadron Honoured

AT a ceremony held at R.A.F. station, Khormaksar on April 9th the Governor of Aden, Sir Tom Hickinbotham, presented No. 8 Squadron, R.A.F., with the standard awarded by King George VI.

No. 8 Squadron, commanded by S/L. A. J. Houston, has served in Aden intermittently over a period of 25 years, and is the senior fighting force in the colony. Personnel from R.A.F. Khormaksar were drawn up for the ceremony in a hollow square around the perimeter of the parade ground and the officers and men of the Squadron marched on with the cased standard at their head. The Governor inspected the Squadron before the standard was uncased and unfurled. The Senior R.A.F. Chaplin then held a short service of consecration, at which the standard bearer, P/O. R. E. Pyrah knelt to receive the newly-consecrated standard. The ceremony, at which Air Officer Commanding Headquarters British Forces, Aden, A.V-M. S. O. Bufton, was present, ended with all ranks of No. 8 Squadron marching past the Governor, in slow and in quick time, then in review order.

The squadron will parade its standard for the first time on April 27th, when a Guard of Honour drawn from its ranks greets the Queen and the Duke of Edinburgh on their arrival in the colony. The squadron's aircraft will also fly over the *Gothic* in salute.

No. 8 Squadron was formed at Brooklands on January 1st, 1915, as part of the R.F.C., and went to France in April that year. Equipped with B.E.2Cs, it concentrated its efforts on long-range reconnaissance and day bombing until early part of 1916, when it changed its rôle to artillery reconnaissance. It took part in the battles of the Somme and Arras, and co-operated closely with the Tank Corps and did outstanding work in the battle of Amiens, one of the squadron pilots, Capt. F. M. F. West being awarded the Victoria Cross. Disbanded at Duxford in January 1920, No. 8 was reformed in Egypt nine months later. In 1921 it moved to Mesopotamia where it helped to garrison the country and operated against local tribesmen. In April 1928 it moved to Aden. At the outbreak of World War II it began carrying out coastal reconnaissance and anti-submarine patrols and was in continuous action against the Italian Forces in the 1940/41 East African campaign. In 1942 it reverted to the anti-submarine rôle, in which it continued until nearly the end of the war. In May 1945 the squadron was again disbanded, but re-formed later in Ceylon as a special-duties unit employed on clandestine operations behind the Japanese lines. The war with Japan over, the squadron began dropping men, food and supplies to P.O.W. camps and isolated groups of agents. Again disbanded in November 1945, it was re-formed in Aden in the following September. Since then it has returned to its traditional rôle of helping in the Defence and Policing of the Protectorate. This year is the 25th anniversary of its arrival in Aden.

GOLDEN WINGS: The noble, gilded bronze eagle which tops the 50ft-high memorial to members of the Commonwealth Air Forces, to be unveiled by the Queen at Malta on May 3rd. The column was designed by Sir Hubert Worthirg, O.B.E., A.R.A. The eagle, 7ft 9in high, is the work of Charles Wheeler, R.A.

No. 3613 F.C.U. Appointment

THE appointment has been announced of W/C. R. W. Foster, D.F.C., to command No. 3613 (City of Manchester) Fighter Control Unit, R.Aux.A.F., at R.A.F. Bowlee. W/C. Foster joined the R.A.F.V.R. in 1939, and was awarded the D.F.C. after serving with Nos. 605 and 54 Sqns. He subsequently held appointments at H.Q., Allied Expeditionary Air Force, 2nd T.A.F. and H.Q., Fighter Command, after transferring to the Administration and Special Duties Branch. He joined No. 3613 F.C.U. in March 1952.

ROYAL INTEREST in some aeronautical happening at London Airport is displayed by Queen Elizabeth the Queen Mother before leaving in a Viking of the Queen's Flight for Wick. Sir John d'Albiac, the airport commandant, seen with Her Majesty, was doubtless able to offer an explanation.

TO THEIR GREATER GLORY: Mr. A. M. Stammers at work on the stained-glass window of the Bomber Command Memorial, which, as related in the news-item below, is to be unveiled in Lincoln Cathedral on May 8th.

Bomber Command Memorial Window

THREE former Air Officers Commanding-in-Chief, R.A.F. Bomber Command, will be present in Lincoln Cathedral on Saturday, May 8th—the ninth anniversary of VE-Day—to honour the memory of 55,500 members of Bomber Command aircrew killed in World War II. They will be Marshal of the Royal Air Force Sir Arthur T. Harris, who was in command from 1942 until the end of the war, Air Chief Marshal Sir Hugh P. Lloyd (1950 to 1953), and Air Marshal Sir R. E. C. Peirse (1940-1942).

The Secretary of State for Air, Lord De L'Isle and Dudley, V.C., members of the Air Council, senior R.A.F. officers and relatives of the dead aircrew will witness the dedication, in the small Airmen's Chapel, of a stained-glass window, described in our issue of March 26th and illustrated on this page.

The Lord Bishop of Lincoln, the Right Reverend M. H. Harland, will officiate, and the window will be unveiled by the present A.O.C-in-C. Bomber Command, Air Marshal Sir George H. Mills. A guard of honour from R.A.F. Station Scampton will line the approaches to the west entrance of the cathedral as the members of the congregation arrive for the ceremony at 3 p.m. The band of the R.A.F. College, Cranwell, will be in attendance.

Relatives may obtain tickets for the ceremony by applying to the Sub-Dean, Lincoln Cathedral, enclosing a stamped, addressed envelope. Tea will be available to them in the grounds of Lincoln Castle.

The R.C.A.F—

THE 30th anniversary of the founding of the R.C.A.F. was celebrated in London on April 1st with a dinner given by A. Cdre. Costello, C.B.E., C.D., Air Member of the Canadian Joint Staff in London. The dinner was held at the R.A.F. Club and the guests included the Rt. Hon. the Lord De L'Isle and Dudley, V.C., Secretary of State for Air, Air Chief Marshal Sir John Whitworth Jones, Air Member for Supply and Organization, and senior officers of the R.A.F. and Commonwealth Air Forces.

—and the I.A.F.

THE 21st anniversary of the Indian Air Force was celebrated on March 28th with an air display at the Tilpat Range, near Delhi. The Indian Prime Minister, Mr. Nehru, arrived in a Sikorsky S-55 to open the proceedings, which included flypasts, and firing and bombing demonstrations by Spitfires, Vampires, Ouragans, Harvards, a C-119 and Liberators. Light anti-aircraft guns fired at target drogues towed over the range by Dakotas, and a battalion of the Kumaon Regiment also made a mass parachute jump from a formation of Dakotas.

The anniversary was also marked by a reception at the Indian Services Club in London.

Farewells to Gen. Griswold

THE Air Council recently gave a dinner in London to honour Maj. Gen. Francis H. Griswold, who is relinquishing his appointment as commander of the 3rd U.S.A.F. in Britain. Besides Maj. Gen. Griswold, the guests—who were welcomed by the Rt. Hon. the Lord De L'Isle and Dudley, V.C.—included Brig. Gen. James C. Selser and Col. C. F. McGuire.

On April 14th, in the Air Council Room at the Air Ministry, there was a reception in honour of Maj. Gen. Griswold.

New Carriers

THE two new light fleet carriers of the *Hermes* class, each displacing 18,300 tons, will come into operational service with the Royal Navy during this year. The first, H.M.S. *Centaur* (Capt. H. P. Sears, R.N.), is already in commission and is beginning her trials. She was fitted, at the Royal Dockyard, Portsmouth, with the new angled deck. The second, H.M.S. *Albion*, is nearing completion on the Tyne, and is due to be commissioned at the end of May. She also has the angled deck.

The flight-decks of both ships are 737ft long by 120ft wide. Canvas bunks are fitted for all ratings and accommodation in general conforms to the latest standards. The newest internal communication and quick-fire systems are fitted. Multiple and single-barrelled Bofors anti-aircraft guns are controlled by close-range director systems.

R.A.F. Appointments

THE following list is a continuation of that given in our "Service Aviation" pages last week:

To instruct, W/C. J. F. Hatton is posted to No. 2 School of Technical Training and W/C. J. F. Brown, B.E.M., to No. 3 Radio School.

In the Technical Branch W/C. G. H. Thomas, M.B.E., is now at Tangmere, W/C. J. R. W. Wright at H.Q. Central Signals Area and W/C. N. W. Wakelin with the R.A.F. Selection Board.

W/C. C. L. W. Stewart, D.S.O., D.F.C., has gone to Ternhill for flying duties and W/C. F. O. S. Dobell to Bassingbourn for similar duties.

G/C. L. G. Brown is appointed Deputy Provost Marshal (U.K.); W/C. S. E. C. Walker, D.S.O., now commands No. 5 Wing R.A.F. Regt.; W/C. J. T. Shaw, D.S.O., D.F.C., is at H.Q. No. 12 Group for air staff duties and, likewise, Act. W/C. C. K. Street, M.B.E., has gone to H.Q. Bomber Command. W/C. F. R. Bird, D.S.O., D.F.C., is now at the M.o.S.

DRESSING SHIP: As H.M.S. "Eagle" enters Gibraltar harbour, following an exercise in the Western Mediterranean, Attackers, Sea Hawks, Avengers and Skyraiders line her deck, with members of the ship's company. The Attackers have rocket attachments, and the Sea Hawks carry under-wing tanks.

THE INDUSTRY

Heat and Efficiency

THE remarkable extent to which gas is used for process heating in a large aero-engine factory was made apparent during a recent visit paid to the Bristol engine division by Col. Sir Harold Smith, chairman of the Gas Council, Mr. C. H. Chester (chairman, South Western Gas Board) and representatives of the gas industry.

The engine division, in fact, uses some 80 per cent of the 270 million cubic feet of gas consumed annually by the company, and, with the continuing need for new installations, the South Western Gas Board has its own liaison and maintenance department in the factory.

In the heat-treatment and enamelling shops, which use some 106m cu ft of gas a year, the visitors saw gas-turbine and piston-engine components being processed in gas-fired plant which includes carburizing and refining furnaces; tempering and quenching tanks; enamelling ovens; plating vats; and rust-proofing tanks. They also watched such bench-work as the brazing of copper-finned cylinder heads.

In the precision foundry (which uses 20m cu ft of gas each year) they studied the casting of typical parts—e.g., turbine stator segments—which can neither be machined from the solid nor easily fabricated; for such work the now well-known investment-casting or "lost-wax" process is extensively used.

Other departments inspected by the party included the light-alloy foundry—whose furnaces and associated equipment consume 26m cu ft of gas annually—and the blade-forging shop (gas consumption, 14m cu ft), where seven furnaces heat the steel blanks from which Olympus and Proteus blades are forged. In this work, accurate temperature-control is particularly important, for either too little or too much heat can very easily result in breakdown or cracking of the material.

Turbojet Test-house Silencing

IN our "Power Units of the World" Number (April 9th) we reproduced a photograph of a Rolls-Royce Avon RA.7 under test at the Banner Lane, Coventry, works of the Standard Motor Company. It is now learned that the silencing equipment employed for these particular test-houses is, in fact, the latest installation of this kind by Cementation (Muffelite), Ltd., of 39 Victoria Street, London, S.W.1. It is actually a rather larger version of five similar installations which this firm carried out in connection with the Bristol Aeroplane Company's contract for Avon production.

Cementation (Muffelite), Ltd., have previously installed test-house silencing for the Standard Company: they provided the equipment for 22 test-houses when the Coventry firm were engaged on large-scale Hercules production during the war.

Recent contracts include the silencing of two new Proteus test-houses for the Bristol Company; and Cementation are now starting on the installation of new equipment for three other Bristol test-houses which they originally silenced some twelve years ago, and which have since been in more or less continuous use, mainly for Centaurus engines but latterly for the Proteus. The firm has also been responsible for the silencing of an unorthodox wind-tunnel installation, details of which have yet to be made public.

Western Manufacturing Estate Report

ISSUED in advance of the recent annual general meeting, the chairman's report on the progress of Western Manufacturing Estate, Ltd., says that the company have continued to extend their activities in the production of components for most of the main aircraft constructors. During the year under review the production of major components for the Hawker Hunter had steadily increased.

The company have also been successful in obtaining orders for the supply of aircraft components under the offshore purchase programme. Although the initial orders are not substantial, an increase in the volume of business from this source can be expected.

Western Manufacturing's well-known products in the field of actuators and aircraft accessories enjoyed increased sales during the past year; and, apart from normal development work, a number of experimental and development contracts are undertaken for various Government departments and main aircraft companies. To permit this work to be carried out as efficiently as possible, the company have added to their technical staff at all levels and increased their design, development and laboratory facilities.

Much of the work, says the chairman's statement, is of a specialized and high-precision nature, for which it is reasonable to expect a continuing, though fluctuating, demand, especially as an increasing proportion is for industries other than armament.

AUSTRALIA TO BRISTOL: Mr. B. F. Letcher, of the Australian Departments of Defence Production and Supply, recently visited the Bristol Aeroplane Company's aircraft and engine divisions and guided-missile laboratory. He is here seen between (left) Dr. S. G. Hooker, engine division director and chief engineer and (right) Sir Alec Coryton, engine division managing director.

Old and New

EACH year, at about this time, Elliott Bros. (London), Ltd., hold an informal cocktail party for their friends in the industry and Government departments, and make a pleasantly original point of selecting one of London's historical houses as the venue. Last year they chose Dr. Johnson's house in Gough Square, Fleet Street; this year the choice was the fine Georgian house in Stratford Place, Oxford Street, which, now owned by Hutchinsons the publishers, was once the home of Lord Derby.

The idea is partly to signify the old-established nature of the Elliott organization as instrument makers (it was founded well over 100 years ago). If the aeronautical side does not go back so far as this, it is by no means new: on display at the party was a 1909 front cover of *Flight* advertising the company's products.

Alongside it were the original drawings—on good old-fashioned tracing cloth—of the Elliott fuel-flow meter designed in 1916 and used on R.F.C. aircraft. Could they have been displayed also, the drawings of the firm's products today—such as guided-missile control components and auto-stabilizers for supersonic aircraft—would have made an interesting comparison between simplicity and intricacy.

Among those who accepted invitations to the party were Sir Steuart Mitchell, K.B.E., C.B., O.B.E., M.I.Mech.E., Controller of Guided Weapons and Electronics, M.o.S.; Sir John Buchanan, C.B.E., F.R.Ae.S., A.M.I.Mech.E., a former technical director of Short Bros., Ltd., and R.Ae.S. president, and now chairman of the London and S.E. Regional Board for Industry; designers from several aircraft firms; and technical officers from the Italian and French embassies. In the last connection, it will be recalled that the Elliott auto-stabilizer has been successfully installed in the Mystère 4 (see *Flight*, December 18th, 1953).

IN BRIEF

The directors of Titanine, Ltd., manufacturers of aircraft and other finishes, report a 1953 net trading profit of nearly £82,000, as against £40,000 in 1952. The new figure is a post-war record.

* * *

Desoutter Brothers (Holdings), Ltd., report a 1953 profit of £127,938, after deduction of taxation at £254,243; the 1952 profit was £65,366. Home sales increased by 12 per cent, and export business—despite heavy competition—by nearly 3 per cent.

* * *

Burgess Products Co., Ltd., Team Valley, Gateshead 11, have issued data sheets, with fully dimensional installation drawings, for their range of micro-switches.

* * *

From the National Institute of Engineering, 148 Holborn, London, E.C.1, comes an impressive list of successes scored during 1953 by various pupils who took the Institute's courses in engineering and other subjects, in nearly all cases in their spare time.

* * *

W/C. Vaughan-Fowler (editor of *Indian Skyways*, Bombay) has joined with a group of friends to form a new company under the title of Aeronautical Publications of India, Ltd., with registered offices at 2 Gandhigram Road, Juhu, Bombay 23. Its objects are "to further the development of all forms of aviation in India and Asia."

* * *

Recently formed to manufacture plastics extrusion equipment of advanced design, and to act as consultants in moulding, extrusion and other processes, is the firm of Maniplastics, Ltd. Directors are Messrs. H. E. Barton, P. J. Garrini, J. R. Gillum and C. G. Colclough, while in charge of the factory and designs side is Mr. L. G. H. Cantle, who was controller of Reid and Sigrist's experimental department during the war. The new company's offices are at Mortgramit Square, Hare Street, London, S.E.18.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Pilots' Insignia

From Sir Hamish MacLaren, K.B.E., C.B., D.F.C.

I MUST first thank you for the pleasure you have recently been affording to pilots of the Kaiser's War by publishing articles and photographs of our aircraft. Many of them have resulted in little get-togethers in my department.

In your issue of March 19th you published a photograph of two Camels of No. 1 Squadron, R.N.A.S., and it was a joy to recognize the familiar tail markings of that famous fighter squadron.

I have, however, to raise two points: (1) The Royal Naval Air Service squadrons were not [to quote the writer of the letter] "attached to the R.F.C. in France." They were operating independently in the Somme and Dunkirk areas. (2) I served in France during the period of transition to the R.A.F. and up till the armistice—November 11th, 1918—and I have no recollection of any instructions preventing us from adopting markings of our choice. If there were such instructions, they must have been more honoured in the breach than the observance. I observe that your correspondent's photograph is stated to have been taken about August 1918, i.e., five months after the R.A.F. was formed.

Combe Down, Bath. HAMISH MACLAREN.

"Spinning Jennies"

THE correct service name of the "Spinning Jenny" was "Sop-with Two-Seater Scout" and its nearest relation was a float seaplane known in the R.N.A.S. as the "Daily Mail," the first having been built for a seaplane race round Britain.

The description of the "Spinning Jenny" given in Mr. L. T. Mason's letter in *Flight* of February 26th is correct except that the centre section consisted of four vertical tubular struts.

The observer's cockpit, being well forward, resulted in a large side surface ahead of the c.g., which may have accounted for the machine's tendency to spin at the slightest provocation. Unlike more stable and many more modern aeroplanes it had the advantage of an equally quick and easy recovery from a spin.

Two "Spinning Jennies" were sent to Killingholm, near Immingham Dock, in 1915, and it was one of these (No. 1055, I think) which you refer to as having been spun intentionally.

These two used to be sent up after Zeppelins, the observer being armed with a Mauser rifle in order to fire a type of incendiary bullet obtained from Germany before the war.

As regards performance, the acceptance test in those days consisted of a climb of 3,000ft and stay there for twenty minutes. The climb used to take about 20 minutes and the top speed low down was about 55 to 60 knots. This climb was not quite as good as the Curtiss J.N.4s, which were also at Killingholm, but the speed was slightly better. J. C. BROOKE,

London, W.1. S/L., R.A.F.(Ret.).

Wave Flying

I FOUND your summary [April 2nd] of the American report on wave flying most interesting, as it adds emphasis to my own article on the subject which you published in *Flight* ("The Higher the Fewer," March 14th, 1952).

The three conditions mentioned in the summary as favouring the formation of waves should not be taken as being the only necessary conditions. There is evidence of wave formation in winds of less than 25 knots, and waves have been soared in this country in which, far from there being a consistent flow extending several thousand feet above the mountain top, the wind has decreased steadily with height, even to zero at some medium level, with possibly an opposite or very different wind above that. A common feature seems to be either a reasonably marked change in either strength or direction or both, with height.

It is certainly true that an inversion or a stable layer favours wave formation. It also makes it easier to see the waves outlined in the upper surface of the cloud layer trapped below it; but according to our own experts a wave motion can exist in the lee of hills even in unstable air so long as that air is stably stratified, i.e., vertical mixing of the air layers is not taking place, and waves and cumulo-nimbus clouds can exist close together in the same air mass. This I have seen in the Lake District and in Scotland.

A point which does not appear to have been mentioned so far is the similarity of conditions under which lee waves and jet streams exist, and it certainly seems reasonable to suppose that the wind gradient associated with a jet stream would cause or accentuate waves over hills.

A friend of mine flying a Dakota in Scotland in a very moist airstream complained that the aircraft became unstable, and he could not trim it to fly level or to maintain a constant airspeed. This case was typical of the impression given when one flies by instruments in wave conditions, which were extensive on that occasion. A closer analysis of his instruments would have revealed, however, that the airspeed rose when the aircraft climbed, and decreased when height was lost—just the opposite of what happens in the "phugoiding" of an unstable aircraft. I have personally recorded steady airspeed fluctuations (i.e., not in turbulence) of plus and minus twenty knots from the trimmed level speed while flying at the same angle of incidence through, respectively, the up and the down sides of waves. If one tries to maintain a steady height, as is required by air-traffic clearances, the divergence from the trimmed level speed can be much larger.

Finally, the mountains causing a wave system do not have to be of the ten-thousand-foot variety, though naturally these excel. A two-hundred-foot hill can give rise to soarable waves, though of course these are unlikely to be dangerous to aircraft unless they are scraping about at hill-top level. It is when the slopes are steep, and the winds are in the forties, fifties and sixties, that you can expect vertical rates of two thousand to four thousand feet per minute, in which the climb performance of the average civil aeroplane is quite inadequate to save the situation, and in which the situation must therefore be avoided, either by going round the mountains or by adopting a really sensible safety height.

Sutton, Surrey. J. C. NEILAN.

The Value of Draughtsmanship

IT was most interesting to read the account of the life of the late Capt. Frank Barnwell (reported in your issue of *Flight* for March 19th) as given by Major Bulman at the R.Ae.S. Memorial Lecture at Bristol.

In particular, Mr. C. W. Tinson's tribute, which mentioned Capt. Frank Barnwell as being "essentially a draughtsman" and a very clever one at that, was indeed a great tribute to all that draughtsmanship implies. This is a truism which to my mind is the underlying reason for the qualities so often found in the draughtsmen of a decade ago and which went into the making of those later to emerge as great engineers or designers.

Mr. Tinson also mentioned that Barnwell was of the "old school." Yes, but he had an inborn gift for inventiveness and design; his neatness, and the practicability of his ideas, were paramount proof of his love for the craft he decided to follow in early life, proving that draughtsmanship combined with a good practical training is necessary to become a successful engineer.

If painstaking work on the drawings such as Barnwell produced were the thing of today in this atomic age, draughtsmen would be enjoying recognition in their craft, with a status comparable with that of engineers or other professional classes. But, alas, very few draughtsmen today remain in the craft; they seek the more remunerative posts found in other occupations.

After nearly 40 years on the drawing board, 30 of them engaged in the design of equipment for use in Service aircraft, I feel I can claim to having knowledge of the values of being "essentially a draughtsman."

Farnborough, Hants. G. L. MILLER.

Rotating-Wing Ultra-Lights ?

"FLYING for all" can become possible only when simple aircraft are cheap in an absolute sense; today such "cheapness" is only relative to higher-performance types. There is thus a definite limit to cost reduction with present aircraft, and the solution must lie in the design of a much simpler type. This could not satisfy those who wish to indulge in aerobatics, but those potential private owners content to cruise sedately over the countryside of this small island, most of which can be reached in reasonable time at quite moderate speeds, might be adequately served by genuine simplicity.

Experiments with unpowered rotating-wing aircraft provided some of the most interesting, but least publicized, development work of the last war.

Focke-Achgelis, in Germany, produced the Fa 330 Bachstelge (Sandpiper), a giro glider, which, towed as a kite by U-boats, provided an invaluable flying observation-post. The necessity to dismantle this aircraft rapidly in emergency and stow it in the small space available in a submarine was met by very careful simple design. A single steel tube sufficed as "fuselage"; another, hinged to it to fold for stowage, was the rotor pylon; control linkages, from joystick to rotor head, and from rudder pedals to rudder, passed within these tubes. Fin, rudder, and tailplane,

CORRESPONDENCE . . .

without elevator, were flat wood and fabric; a fin fitting into a socket, and another (spring loaded) attachment, were the only means of assembly for each. Three fabric-covered rotor blades (ply ribs with sheathed leading edge) on a tubular spar provided lift in normal Autogiro manner; with 24ft rotor diameter, weight without pilot, was 180 lb. This version had landing skids, but some, fitted with wheels, were towed by Fiesler Storch aircraft.

I am of the opinion that, with a small engine driving a tractor airscrew, a machine of this kind would be suitable for amateur construction without great expenditure of time or money. It could be dismantled and stored in the average garage, alongside, not instead of, the family car, which could be used to transport the pieces to and from the operating site.

Invaluable advice to all interested in building and flying light aircraft is offered by the technical experts of the Popular Flying Association; but research is needed, and could be provided by something similar to the Low Speed Aerodynamics Research Association, which grew from the aeromodelling movement, and which has developed a radio-control unit, to provide valuable research, with models, into spinning characteristics of full-size prototypes. Finance is the biggest problem. It might be solved by large aircraft firms providing cheap wind-tunnel facilities; not mere philanthropy—any assistance to those who work to further airmindedness would constitute a wonderful long-term investment.

Simplicity must be retained; refinements, other than any essential to safety, can only increase costs. Development of a suitable engine would need much time and money, but a motor cycle engine, of perhaps only 500 c.c. should suffice and, with modifications and airscrew, might cost about £100. The airframe could be constructed by amateurs—a team of welder, carpenter and mechanic would be ideal, but almost anyone, with professional assistance from a welder, could build it; purchase tax would be avoided. Some patent royalties might be payable, and a few instruments and specialized components necessary, but costs should be within a further £100.

FORTHCOMING EVENTS

April 24. British Interplanetary Society (North-west branch): Film show.
April 24. British Interplanetary Society (Provisional Western branch): Exhibition and film show.
April 27. R.Ae.S. Section Lecture: "Aerodynamic and Aerolastic Characteristics of the Crescent Wing," by G. H. Lee, B.Sc., D.I.C., A.R.C.S., F.R.Ae.S.
April 28. Aéro-Club d'Italia: International helicopter meeting.
April 28-May 1. Institute of Welding: Spring meeting, Porthcawl and Bristol.
April 29. R.Ae.S. Graduates' and Students' Section: "Fuselage Structural Design Methods," by R. J. Jupe, A.F.R.Ae.S., G.I.Mech.E.
May 3-14. British Industries Fair, London and Birmingham.
May 4. R.Ae.S. Section Lecture: "Propellers for High-Speed Aircraft," by G. C. T. Gardiner, A.F.R.Ae.S.
May 6. R.Ae.C.: Annual general meeting.
May 9-16. Saar Aero Club: International gliding contest and rally.
May15-17. Channel Islands Aero Club: International rally, St. Peter's Airport, Jersey.
May17-28. Gauge and Tool Exhibition, New Horticultural Hall, London.
May 20. R.Ae.S.: 42nd Wilbur Wright Memorial Lecture: "The Choice of Power Plants for Civil Aeroplanes," by Dr. A. E. Russell, B.Sc., F.I.A.S., F.R.Ae.S.
May 22. Leicestershire Aero Club: Air display.
June 9-19. Mechanical Handling Exhibition and Convention, Olympia.
June 13. R.Ae.S. Garden Party, London Airport.
June21-24. Institute of the Aeronautical Sciences: Annual summer meeting, Los Angeles.

R.Ae.S. Branch Fixtures (to April 30).—April 23, *Hatfield*, annual dinner. April 28, *Coventry*, annual general meeting and films; *Southampton*, "Recent Developments in Civil Engineering," by Dr. A. G. Pugsley. April 30, *Birmingham*, "Aircraft Electrics," by R. H. Woodall and J. H. Rea.

Such an aircraft, easy and quick to produce, with initial cost below £200, little maintenance, no hangarage if the owner has a garage, very low fuel consumption, and easy to fly, would be of great interest, not only in offering cheap flying, but, as a direct consequence, proving if real interest exists. There are two and a half million cars in this country; in comparison, even the costs and regulations that bedevil private flying cannot entirely explain the relative handful of aircraft.

Cambridge. PEDANTICA.

HELICOPTER NAVIGATION DISCUSSED

LAST week we gave a summary of the paper on helicopter navigation delivered to the Helicopter Association on April 9th by Mr. D. M. Davies, senior helicopter engineer of the Fairey Aviation Co., Ltd. Below are notes on the discussion which followed the lecture.

MR. G. M. MACINTOSH (M.T.C.A.) opened by saying that although he agreed that the Decca radio aid would probably prove to be the most suitable for use in helicopters, he felt that the H.F. systems should not be entirely overlooked. The radio aid used would depend largely on the crew composition of future transport helicopters. Referring to the lecturer's stated requirement for a landing radio aid in addition to an *en route* aid (such as Decca), he thought it would be a pity if Decca could not be made to fulfil both functions. Aviation was becoming more and more complex and it would be regrettable if the helicopter were to be organized out of existence when it was hoped that it would provide a means of simplifying air travel.

As a practical consideration, the majority of rotorstations would probably be administered by a local authority and not the M.T.C.A., and the cost of installing radio landing aids might be prohibitive. He asked whether the gyro-magnetic compass, which had proved most valuable to fixed-wing aircraft, had been brought into use in helicopters.

W/C. J. L. MITCHELL (Air Ministry) outlined the military functions of the helicopter as being: (1) Rescue; (2) maritime warfare; (3) army support. He said that the emphasis was on the helicopter's low speed characteristics. He thought that an autopilot was an essential requirement for the military machine and that a radio altimeter was also necessary. Referring to the traffic-control problem, he agreed that where possible the helicopter should conform to the fixed-wing traffic pattern, but that its ability to hover should also be exploited in the controlled-approach phase. Military helicopters would need a let-down radio aid and the Decca Navigator seemed attractive in this respect.

MR. J. A. PREISS (A.andA.E.E., Boscombe Down) stressed the Naval requirement for the navigation of helicopters when radio silence was enforced. In these circumstances D.R. navigation had to be used and results and trials had brought to light a number of discrepancies in the indications of magnetic compasses when fitted to helicopters. This factor, combined with airspeed inaccuracies due to inconsistent position-errors, had led to larger vector errors in oversea navigation than the Navy could accept. The maximum permissible vector error in D.R. navigation was 5 per cent and to achieve this the compass problem had to be solved. His establishment had experienced no difficulty in installing a gyro-magnetic compass in one of their machines, but, up to the present time, its operation had been adversely affected by the low-frequency vibration of the helicopter.

W/C. E. F. TONGE (Admiralty Compass Observatory) said that results of experimental work done by the A.C.O. confirmed Boscombe Down's findings in respect of compass errors. They had supervised the installation of a Kollsman compass in a Westland Sikorsky W.S.51. After swinging the compass on the ground (with the engine and rotors running) all deviation was corrected, but in the air errors were found to be present which resolved themselves into a coefficient C of the order of 6 deg, plus a small random error. The G.4 gyro-magnetic compass exhibited similar characteristics. Experiments were still in progress, with the full co-operation of the manufacturers, to ascertain the source of the discrepancies and to find a remedy.

MR. MACINTOSH asked W/C. Tonge whether the errors might be due to corrector magnet vibration, but W/C. TONGE did not think this could be the cause. DR. G. S. HISLOP (Fairey Aviation) asked whether the effect was similar in the Bristol 171 helicopter and MR. PREISS said that it was so.

W/C. F. W. THOMPSON (Air/Sea Warfare Development Unit) then outlined briefly his unit's navigation experiences with the Bristol 171. They had not been able to attain the accuracy which B.E.A. had achieved and, unlike the lecturer, he thought that in some conditions the pilot seemed to have "built-in yaw."

MR. J. M. BUCKERIDGE (M.T.C.A.) wondered whether a system of approach lighting and high-intensity landing lights could be used in conjunction with the Decca Navigator for bad-weather operations. Such a lighting system would be less expensive to install and operate than a radio landing aid and would not require the constant attention of a skilled radio operator.

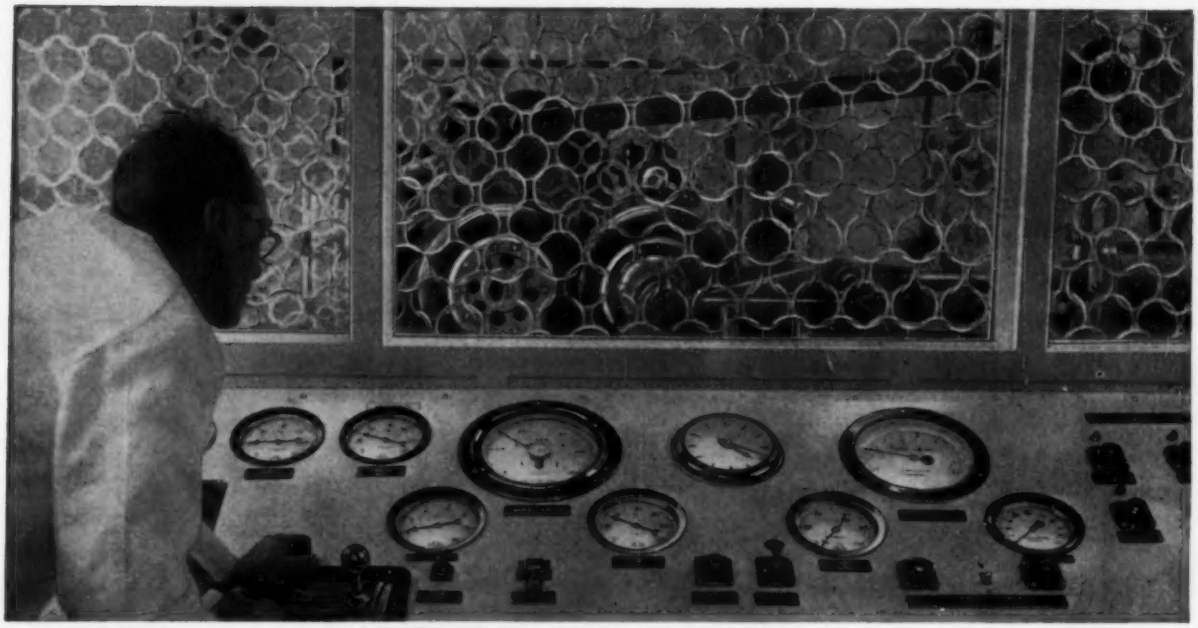
MR. M. MORGAN (Marconi) asked the lecturer what was the change in fuselage pitch angle between the climbing and descending flight attitudes of a helicopter and, also, whether a knowledge of his airspeed was vital to the pilot to maintain flight safety.

DR. HISLOP said he thought the weather minimum of 300ft was too high for helicopter operations and that the design of future transport helicopters would have to be such that they could maintain height in the event of partial power failure. This would enable the operational limitations to be reduced.

MR. DAVIES, replying to the discussion, said that he still considered a radio landing aid to be necessary in conditions of high-density traffic but that the use of high-intensity lighting might well be a good interim measure. He said that the pitch angle was about 5 deg nose-up on the Bristol 171 during descent and about 3 deg nose-down in the climb. The rotor revolutions were more important than airspeed. With regard to the opinions expressed by several speakers on compass discrepancies, all he could say was that in B.E.A. they had not been aware of any such errors. All the B.E.A. navigation trials had, of course, been carried out over land.

Taking-off, Touching-down, Taxying

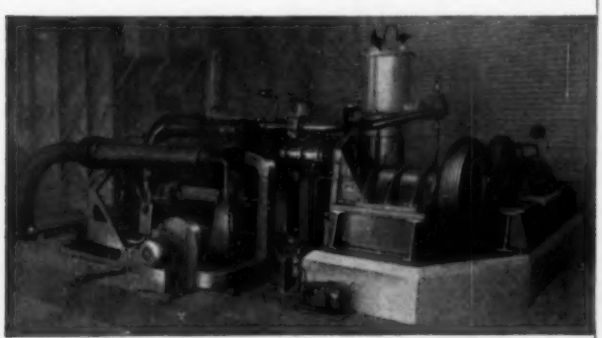
NEW TYRE-TESTING MACHINE REPRODUCES HIGH-SPEED JET OPERATING CONDITIONS



Controlling the progress of an actual test run. The machine can be seen through the double wall of safety glass, beyond the protective steel torpedo netting

PERMITS CLOSE, ACCURATE STUDY OF AERO TYRE BEHAVIOUR

The startling progress of aeronautical design in recent years, so greatly influenced by the development of the jet engine, has confronted the tyre designer with complex problems. Thinner wing sections, which reduce retraction space, create a need for smaller-section tyres. But they also indicate higher performance — and a correspondingly bigger strain on wheel equipment. Just how successfully Dunlop has overcome these problems may be judged by the wheel equipment now fitted to the "Comet," the "Viscount" and many other advanced Civil, Military and Naval aircraft.



The test plant, showing the Merlin engine, the test-tyre and, on the far side, the 'slave' tyre and pneumatic ram.

An indispensable aid in all this work is test equipment capable of simulating actual operating conditions—both as they are now and as they are likely to be in the future. Here Dunlop has a unique advantage—a test machine that reproduces, for close and accurate study, the complete life-cycle of a high-speed jet aircraft's tyre. Mounted in a specially-constructed, well-protected building, the new plant is powered by a Rolls-Royce Merlin aero engine developing 1,725 b.h.p. at 3,000 r.p.m. — equivalent, with some tyres, to a surface speed of 300 m.p.h.

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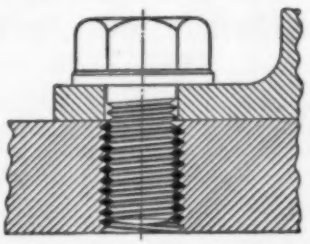

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PUBLIC ANNOUNCEMENTS

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THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

APPLICATION No. 290 from British Overseas Airways Corporation, of Airways House, Great West Road, Brentford, Middlesex, for permission to include Perth as an alternative traffic stop to Darwin on their normal scheduled service between London and Sydney, operated on the route set out as Route No. 1 in Schedule "A," Part I, of the terms of reference issued to the Air Transport Advisory Council by the Minister of Civil Aviation on July 30th, 1952.

APPLICATION No. 56/1 from Silver City Airways, Ltd., of 1 Great Cumberland Place, London, W.1, for amendments to the terms of approval by the Minister of their vehicle ferry services on the routes Lympne-Calais, Lympne-Le Touquet, Lympne-Ostend, Gatwick-Le Touquet and Southampton-Cherbourg to permit the operation of Dakota aircraft in addition to the types already approved.

THESE applications will be considered by the Council under the terms of reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to these applications must be made in writing, stating the reasons, and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 9 Buckingham Gate, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [1924

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The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

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INTERVIEWS are offered to aircraft draughtsmen and stressmen in the London area by The English Electric Co., Ltd., at 336 Strand, W.C.2, on Saturday April 24th between 9 and 12 noon. These interviews will be in confidence and without obligation. There are opportunities for employment in the London design office and at Warton in Lancashire. [1904

ARMSTRONG SIDDELEY MOTORS require fully experienced aircraft instrument mechanic. Must be capable of Calibration of Experimental Aircraft Instruments including electrical installations (*not* radio).—Apply by letter stating experience, and qualifications, to Reference AIM, Personnel Manager, Armstrong Siddeley Motors, Coventry. [1901

TECHNICAL illustrators (male, senior) required. Considerable practical experience of illustrating for sales brochures and descriptive manuals essential. Good welfare facilities including staff pension scheme.—Applications, in writing, to Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Beds, stating age, experience and salary required. [0592

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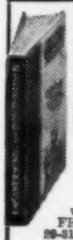

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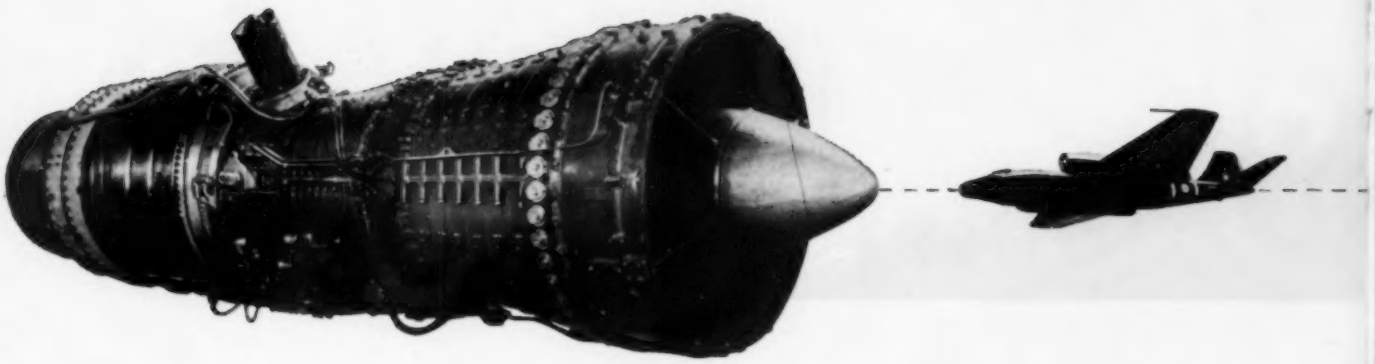

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